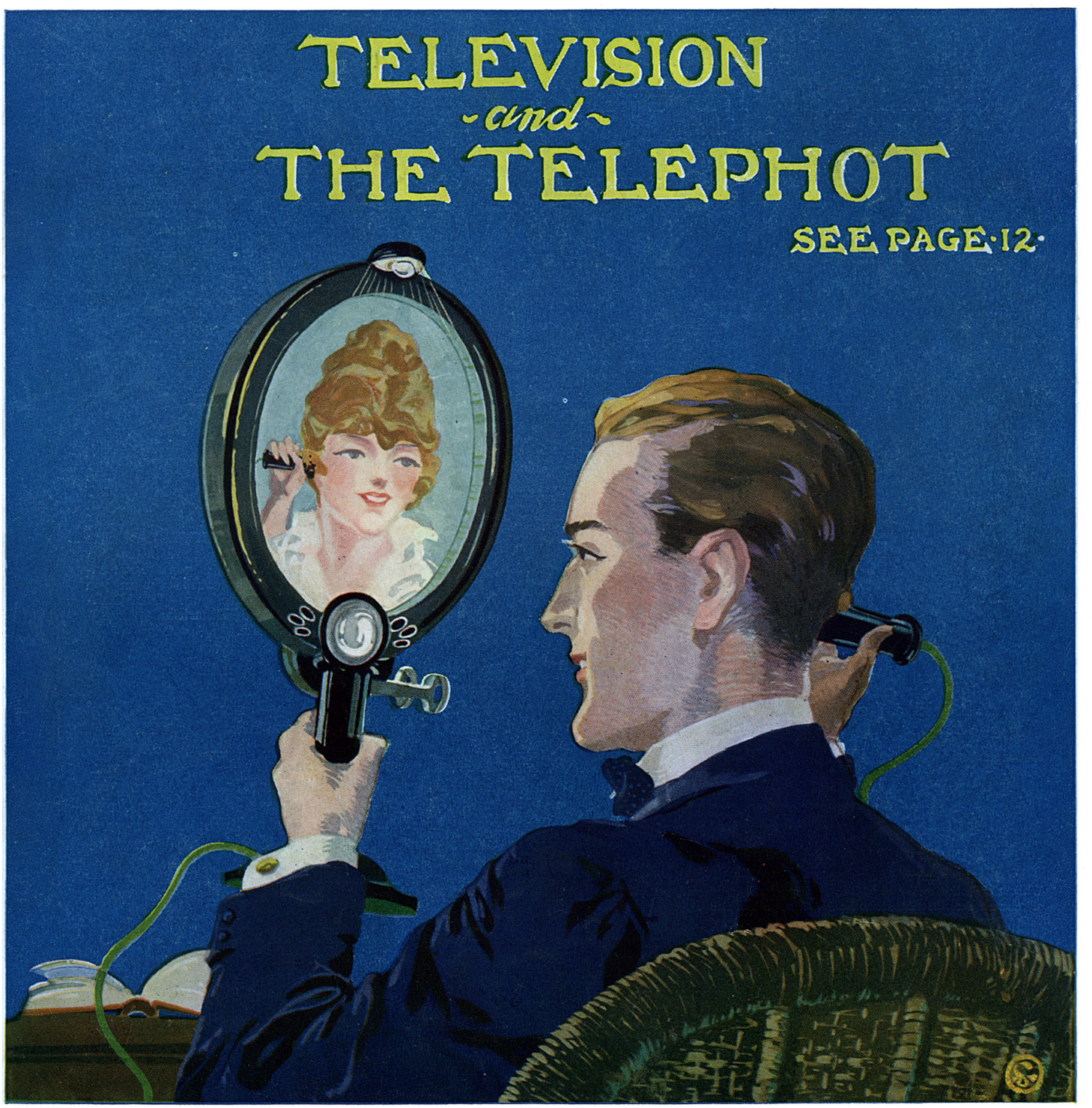
NOTICE TO READER: When you finish reading this magazine place a 1 cent stamp on this notice, hand same to any postal employee and it will be placed in the hands of our soldiers or sailors at the front. *No wrapping—no address.*—A. S. BURLESON, Postmaster-General.

"MAY" 15 CENTS

Electrical Experimenter

OVER 175 ILLUST.

POPULAR ELECTRICAL NEWS ILLUSTRATED



☆ LARGEST CIRCULATION OF ANY ELECTRICAL PUBLICATION

ELECTRICITY MADE SIMPLE

The demand for trained Electricians is immense. Fine positions are everywhere. Experts must be MADE—to fill them. This situation offers you the best chance you'll ever get to forge ahead QUICKLY in this greatest of all professions.

Earn $2500 to $8000 a Year!

QUALIFY for a splendid career through my course. It is simplified to the point of perfection. You'll enjoy it. I and my assistant engineers have worked to make it the most exact, simple, comprehensive and interesting course in America. To show you how PRACTICAL it is—and PROVE you can learn Electricity with SPEED and EASE, I will send you proof lessons—FREE OF CHARGE.

Let a Practical Engineer Personally Train You at Home

YOU CAN DO THIS

AFTER HOME STUDY

$36.00 TO $100.00 A WEEK

L. L. COOKE

The well-known consulting and advisory engineer, formerly member of Engineering Staffs of American Bridge Co., Pressed Steel Car Co., and Millikan Bros., great international engineers, in New York, London and So. Africa.

I will give you the practical training you need — AT HOME. I will PERSONALLY train you in a WORKING knowledge of Electricity in your SPARE TIME. And I am so sure you will make a splendid success in the study of this fascinating profession — that I will give you a GUARANTEE BOND to refund the full tuition cost to you, if you are not entirely satisfied when you receive your DIPLOMA and Electrician's Certificate.

Proof Lessons—FREE!—Free Electrical Outfit!

Act quick and secure a big reduction in cost of tuition. If I hear from you at once I will send you the *Proof Lessons* FREE, and I will also give you a big outfit of Standard size electrical tools, materials, etc., absolutely FREE. Many other valuable benefits too numerous to mention. Send Coupon NOW—for full details. Don't fail—only a practical engineer can teach you the things you MUST know to succeed big—and as Chief Engineer of the Chicago Engineering Works, I am in a position to help you immensely. Send coupon or write today sure!

MAIL THIS COUPON

Dept. 25,
CHIEF ENGINEER, Chicago Engineering Works,
441 Cass St., Chicago, Illinois.

Without obligation on my part kindly send at once, fully prepaid, particulars of your complete Practical Home Study Course in Electricity.

Name .....

Address .....

Town .....State .....

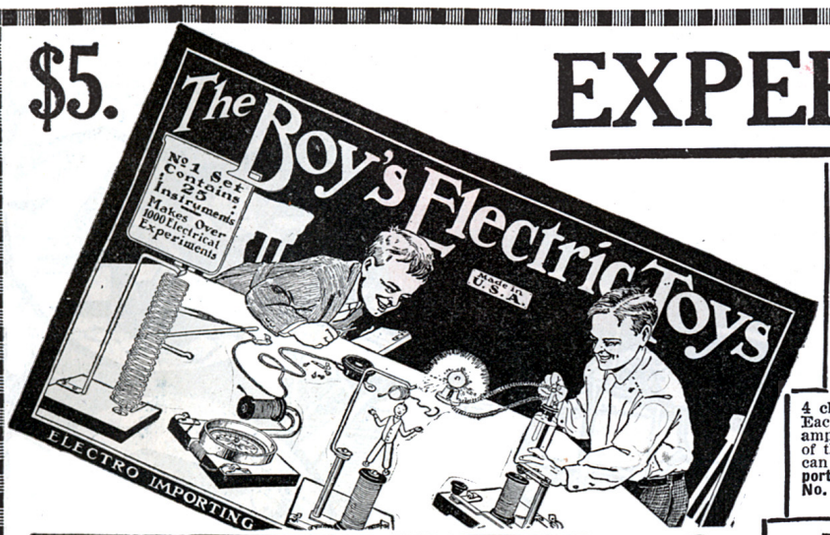
CHIEF ENGINEER COOKE

Chicago Engineering Works

DEPT. 25

441 Cass Street Chicago, Ill.

$5. EXPERIMENTERS!



No. EX2002

"THE BOY'S ELECTRIC TOYS" contains enough material TO MAKE AND COMPLETE OVER TWENTY-FIVE DIFFERENT ELECTRICAL APPARATUS without any other tools, except a screw-driver furnished with the outfit. The box contains the following complete instruments and apparatus which are already assembled:

Student's chromic plunge battery, compass-galvanometer, solenoid, telephone receiver, electric lamp. Enough various parts, wire, etc., are furnished to make the following apparatus:

Electromagnet, electric cannon, magnetic pictures, dancing spiral, electric hammer, galvanometer, voltmeter, hook for telephone receiver, condenser, sensitive microphone, short distance wireless telephone, test storage battery, shocking coil, complete telegraph set, electric riveting machine, electric buzzer, dancing fishes, singing telephone, mysterious dancing man, electric jumping jack, magnetic geometric figures, rheostat, erratic pendulum, electric butterfly, thermo electric motor, visual telegraph, etc., etc.

This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectually.

With the instruction book which we furnish, one hundred experiments that can be made with this outfit are listed, nearly all of these being illustrated with superb illustrations. No other materials, goods or supplies are necessary to perform any of the one hundred experiments or to make any of the 25 apparatus. Everything can be constructed and accomplished by means of this outfit, two hands, and a screw-driver.

The outfit contains 114 separate pieces of material and 24 pieces of finished articles ready to use at once.

Among the finished material the following parts are included: Chromic salts for battery, lamp socket, bottle of mercury, core wire (two different lengths), a bottle of iron filings, three spools of wire, carbons, a quantity of machine screws, flexible cord, two wood bases, glass plate, paraffine paper, binding posts, screw-driver, etc., etc. The instruction book is so clear that anyone can make the apparatus without trouble, and besides a section of the instruction book is taken up with the fundamentals of electricity to acquaint the layman with all important facts in electricity in a simple manner.

We guarantee satisfaction.

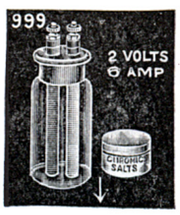
The size over all of the outfit is 14 x 9 x 2¾. Shipping weight, 8 lbs. **$5.00**

No. EX2002 "The Boy's Electric Toys," outfit as described.....

IMMEDIATE SHIPMENTS

ELECTRO IMPORTING CO., 231 Fulton St. NEW YORK

Student's Chromic Plunge Battery



This is an ideal battery for electrical experimental work where a very powerful current is not required. This battery will light a 2 volt lamp for several hours on one charge; it will run a small toy motor surprisingly well; it will do small electroplating work; it is ideal for testing work; it gives a fairly steady current, **and as the zinc electrode can be pulled clear of the electrolyte, no materials are used when battery stands idle.**

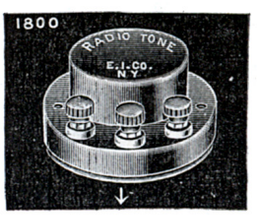
Best Amalgam Zinc only is used, as well as a highly porous carbon to ensure a steadier current. We furnish enough chromic salts for 4 charges. Full directions for operation and care of battery are included. Each battery tests 2 volts and 6 amperes when set up fresh. Not over 2 amperes should be drawn from battery continuously. By using six or eight of these batteries, a great many experiments can be performed. No solution can run out of this battery if upset by accident. This makes it an **ideal portable battery.** Size over all is 5"x2". Shipping weight, 1 lb.

No. 999. Student's Chromic Plunge Battery..... **$0.50**

IMMEDIATE SHIPMENTS

The "Electro" Radiotone

HIGH FREQUENCY SILENT TEST BUZZER



This instrument gives a wonderful high pitched MUSICAL NOTE in the receivers, impossible to obtain with the ordinary test buzzer. The RADIOTONE is built along entirely new lines; it is NOT an ordinary buzzer, reconstructed in some manner. The RADIOTONE has a single fine steel reed vibrating at a remarkably high speed, adjusted to its most efficient frequency at the factory. Hard silver contacts are used to make the instrument last practically forever.

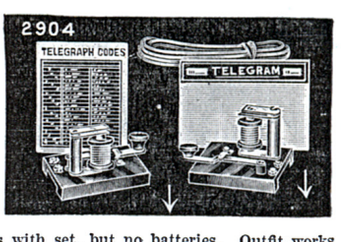
Yes, the RADIOTONE is **SILENT.** In fact, it is so silent that you must place your ear on top of it to hear its beautiful musical note.

You will be astounded at the wonderfully clear, 500 cycle note, sounding sharply in your receivers. **To learn the codes, there is absolutely nothing like it.** With the radiotone, a key and one dry cell and ANY telephone, a fine learner's set is had. Two or more such sets in series will afford no end of pleasure for intercommunication work. **Shipping Weight 1 lb.**

Radiotone as described.....each **$.90**

IMMEDIATE SHIPMENTS

The "Electro" Telegraph



is not a toy, but a practical, honestly built telegraph outfit, which not only sounds but works like the big commercial instruments. By studying the code for 30 days you can become a first-class telegraph operator. Such operators are in big demand now. Outfit consists of TWO complete telegraph instruments each measuring 3½ x 2½ x 2¼. All metal parts are highly nickel plated, including key lever. Note hard rubber knob. Telegraph Code Chart, telegraph blanks and connecting wire comes with set, but no batteries. Outfit works on 2 dry cells (one cell for each instrument). The "Electro" is the ONLY Outfit that works both ways, each station can call: no switches, no extras. Nothing to get out of order. Guaranteed to please you or money back. **Price Complete as illustrated (TWO INSTRUMENTS).. $1.25**

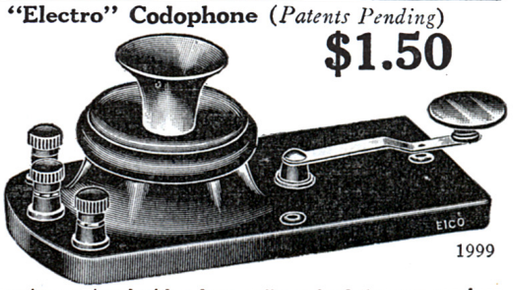
Shipping Weight, 2 lbs.

IMMEDIATE SHIPMENTS

The "Electro" Codophone (*Patents Pending*)

What this remarkable instrument is and does.

$1.50



1999

The "Electro" **Codophone** is positively the only instrument made that will imitate a 500 cycle note exactly as heard in a Wireless receiver. The loud-talking receiver equipped with a horn, talks so loud that **you can hear the sound all over the room,** even if there is a lot of other noise.

THAT'S NOT ALL. By lessening or tightening the receiver cap, a tone from the lowest, softest quality, up to the loudest and highest screaming sound can be had in a few seconds.

FOR INTERCOMMUNICATION. Using two dry cells for each instrument, two **Codophones** when connected with one wire and return ground, can be used for intercommunication between two houses one-half mile apart.

One outfit alone replaces the old-fashioned learner's telegraph set, consisting of key and sounder.

The "Electro" **Codophone** is a handsome, well made instrument, fool proof, and built for hard work. Contacts are of hard silver ⅛ inch in diameter, that will outlast the instrument.

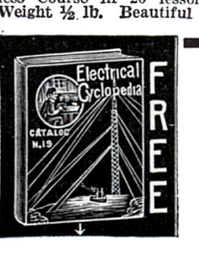
There is also a neat code chart and full directions **enabling any intelligent young man or girl to learn the codes within 30 days,** practising one-half hour a day.

Sizes: 6¾ x 3 x 2⅝". Shipping weight, 2 lbs.

The "Electro" Codophone as described, complete..... **$1.50**

"The Livest Catalog in America"

Our big, new electrical cyclopedia No. 19 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 228 Big Pages, 600 illustrations, 500 instruments and apparatus, etc. Big **"Treatise on Wireless Telegraphy."** 20 FREE coupons for our 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 19 measures 7x5¼". Weight ½ lb. Beautiful stiff covers.



ELECTRO IMPORTING COMPANY

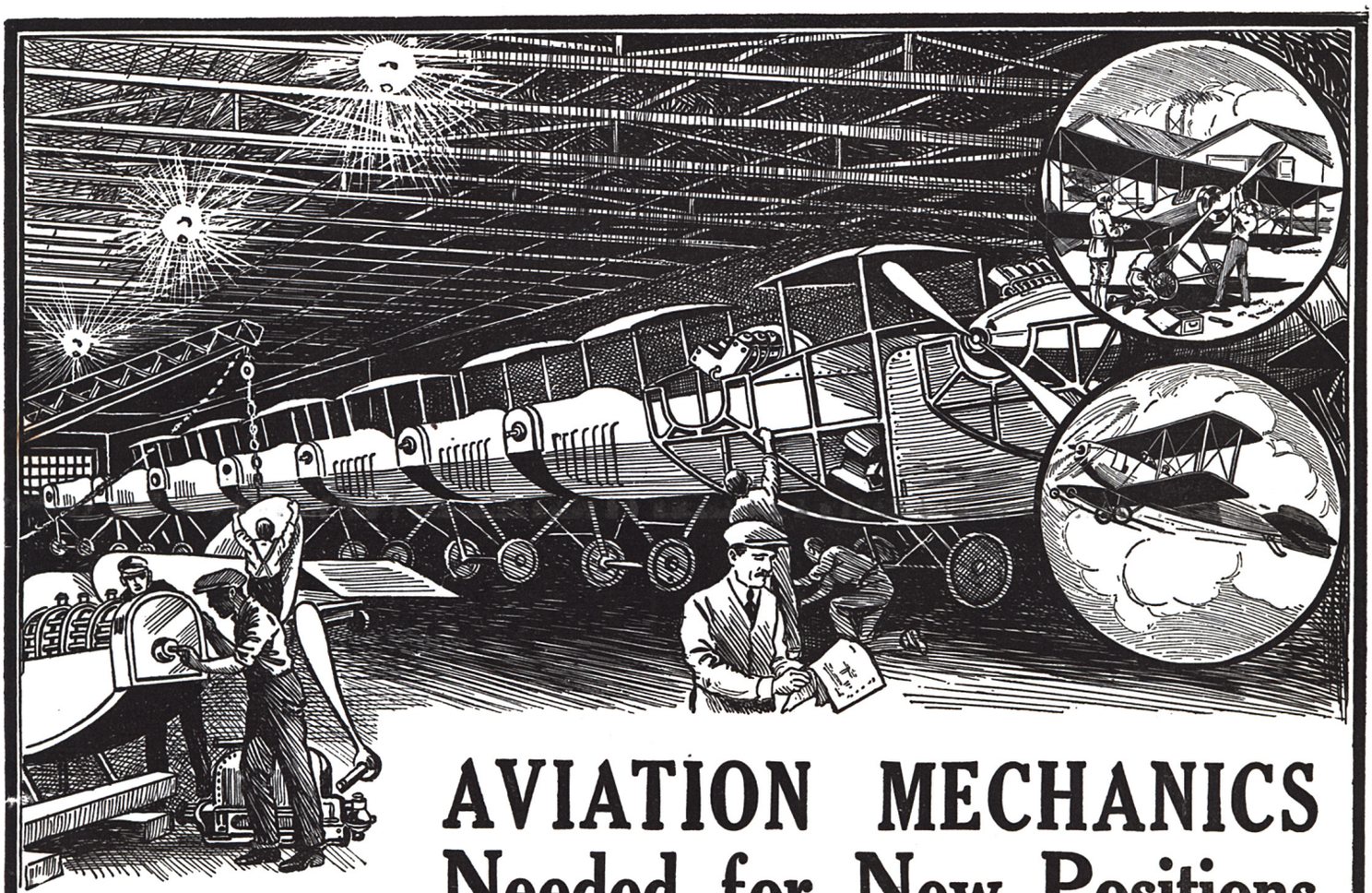
231 Fulton St., New York City

I enclose herewith 6 cents in stamps or coin for which please send me your latest Cyclopedia Catalog No. 19 as described.

NAME .....

ADDRESS .....

STATE ..... E. E. 5-18



AVIATION MECHANICS Needed for New Positions

Thousands of splendid new positions now opening up everywhere in this amazing new field. New Airplane factories being built—automobile and other plants in all parts of the country being converted to turn out vast fleets of Airplanes for our armies in Europe. And only a few hundred expert Airplane Mechanics available, although thousands are needed. And this is only the beginning. Already airplane mail routes are being planned for after the war and thousands upon thousands of flying machines will be wanted for express and passenger carrying service.

Not in a hundred years has any field of endeavor held out such wonderful chances to young men as are offered to you today in the Aviation Industry. Resolve now to change your poorly paid job for a big paying position with a brilliant future. Send the coupon today for Special limited offer in Practical Aeronautics and the Science of Aviation and prepare yourself in a few short months to double or treble your present salary.

Earn $50 to $300 per week as

Aeronautical Instructor
$60 to $150 per week
Aeronautical Engineer
$100 to $300 per week
Aeronautical Contractor
Enormous profits
Aeroplane Repairman
$60 to $75 per week
Aeroplane Mechanician
$40 to $60 per week
Aeroplane Inspector
$50 to $75 per week
Aeroplane Salesman
$5000 per year and up
Aeroplane Assembler
$40 to $65 per week
Aeroplane Builder
$75 to $200 per week

What Our Students Say:

Mr. Stanfield Fries
Fort Bliss, Tex.
My estimation of the new course is excellent; it could positively not be any better.

Mr. Z. Purdy
Shreveport, La.
It is hard to believe that lessons on such a subject could be gotten up in such an interesting manner.

Mr. Lloyd Royer
Haigler, Neb.
I can hardly thank you enough for the way you have personally taken up my enrollment.

Mr. Mayne Eble
Manistee, Mich.
I believe I learn more from my lessons than an aviator who takes his first lesson with an airman in an aeroplane.

We Teach You By Mail

IN YOUR SPARE TIME AT HOME

Our new, scientific Course has the endorsement of airplane manufacturers, aeronautical experts, aviators and leading aero clubs. Every Lesson, Lecture, Blue-Print and Bulletin is self-explanatory. You can't fail to learn. No book study. No schooling required. Lessons are written in non-technical, easy-to-understand language. You'll not have the slightest difficulty in mastering them. The Course is absolutely authoritative and right down to the minute in every respect. Covers the entire field of Practical Aeronautics and Science of Aviation in a thorough practical manner. Under our expert direction, you get just the kind of practical training you must have in order to succeed in this wonderful industry.

Special Offer NOW! *SEND THIS COUPON TODAY*

It is our duty to help in every possible way to supply the urgent need for graduates of this great school. We have facilities for teaching a few more students, and to secure them quickly we are making a remarkable Special Offer which will be withdrawn without notice. Write today—or send the coupon—for full particulars. Don't risk delay. Do it now.

AMERICAN SCHOOL OF AVIATION

431 S. Dearborn Street **Dept. 7444** **CHICAGO, ILL.**

American School of Aviation
431 S. Dearborn Street
Dept. 7444
Chicago, Illinois

Without any obligations on my part, you may send me full particulars of your course in Practical Aeronautics and your Special LIMITED Offer.

Name.....

Address.....

.....

Electrical Experimenter

233 FULTON STREET, NEW YORK

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, President; S. Gernsback, Treasurer;) 233 Fulton Street, New York

Vol. VI Whole No. 61 MAY, 1918 No. 1

TELEVISION AND THE TELEPHOT.....Front Cover
From a painting by Vincent Lynch
ELECTRICITY AND CAMERA GIVE 3,000,000 SHELLS THIRD DEGREE 5
LOCATING AND DESTROYING "SUBS" WITH ELECTRO-MAGNETS 6
YANKEE CODE NOT SO "BLOEDSINNIG"..... 7
NEW SPY AND SCIENTIFIC MOVIES.....By George Holmes 8
ELECTRICITY AND METAL COATED SEEDS BOOST CROPS... 9
THE ELECTRO-MAGNET IN THE OPERATING ROOM.....
By S. Gernsback 10
TELEVISION AND THE TELEPHOT.....By H. Gernsback 12
ELECTRICALLY HEATED BEDS FOR THE WOUNDED..... 14
A NEW PHONOGRAPHIC LOUD-TALKER...By H. Winfield Secor 15
"VOL. VI—No. 1"..... 16
"SUB"-DETECTOR, THRILLER IN NEW WAR PLAY..... 18
SCIENTIFIC RESEARCH ESSENTIAL TO HUMAN PROGRESS
By Dr. Willis R. Whitney 19
MODERN AMERICAN ELECTRIC FURNACES.....
By Frank C. Perkins 20
ELECTRIC "SHERARDIZING" PREVENTS RUST..... 21
FIXATION OF NITROGEN BY ELECTRICITY.....
By Theodore Bodde 23
THE PHENOMENA OF ELECTRICAL CONDUCTION IN GASES
By Rogers D. Rusk, M.A. 25
RADIO DEPARTMENT 26
EXTERNAL GRID VACUUM VALVE CONSTRUCTION.....
by R. V. Clark—3rd 28
THE HOW AND WHY OF RADIO APPARATUS.....
Lesson 8—By H. Winfield Secor, Assoc. I. R. E. 30
DESIGN FOR A PANEL TRANSMITTING SET.....
By James R. Hopkins 31
THEORY OF TUNING, WAVE LENGTHS AND HARMONICS....
By Prof. F. E. Austin 32
BUILDING AN ELECTRIC PIANO PLAYER....By Charles Horton 34
EXPERIMENTAL MECHANICS.....Lesson 3—By Samuel Cohen 36
"SHOOTING" ELECTRICAL TROUBLES ON AUTOMOBILES....
By Thomas W. Benjamin 38
A TIGHT SQUEEZE FOR UNCLE GEORGE.....By Thomas Reed 39
HOW-TO-MAKE-IT PRIZE CONTEST..... 40
WRINKLES, RECIPES AND FORMULAS....Edited by S. Gernsback 41
EXPERIMENTAL CHEMISTRY .....
Lesson 24—By Albert W. Wilsdon 42
WITH THE AMATEURS PRIZE CONTEST..... 43
LATEST PATENTS 44
PHONEY PATENTS—CONTEST..... 45
"THE ORACLE" 46

EDITORIAL

WINNING THE WAR

THIS war, more so than any other, is a machine war. A stereotyped phrase, but, nevertheless, a very true one. When we speak of a machine war, we usually have in mind artillery of all calibres, from machine guns upwards to 42 cm. guns, and larger.

We believe that we will not be contradicted when we state that vast bodies of infantry can not move forward nowadays without the support of protecting artillery from its rear. Logically, the conclusion follows that if we can annihilate the enemy's artillery, he must fall back. Even trench systems without artillery support from the rear can not be held for any length of time by the enemy. If our artillery is intact, but if the enemy is deprived of his, even tho his infantry should outnumber ours ten to one, he would have to retreat just the same. These, of course, are very obvious facts.

The British now engaged in the Western war theater realized this truth very early and set about to rectify it. The result was their present Tanks. These machines fulfill several purposes; they are used to batter down the barbed wire entanglements protecting front line trenches; secondly, they raise havoc among the enemy's men by flank fire once across his lines, but most important of all the Tanks are supposed to annihilate the enemy's artillery either by putting the artillerists out of action by gun fire from the Tank or by climbing right over the enemy's guns, thus putting them *hors de combat*. For the first two purposes the Tanks are ideal; for the latter they have signally failed. The reason is very simple. The Tank is an extremely slow-moving vehicle in the open field—five to eight miles an hour at the most is its speed. Even if camouflaged, a Tank makes a shining mark for the enemy gunners, who find little trouble in getting the range of the slowly crawling tractor. One or two shells soon puts the most ambitious Tank out of business.

Ever since the Tank made its first appearance we have pointed out in many of our articles that on account of its ridiculously slow speed the machine as now built could never be a factor in modern warfare.

In other words, the large and speedy machine obviously is *the* thing in this war. In former articles we have shown that it is perfectly feasible to run monster machines over land at speeds from twenty miles upward. We have shown how our obsolete battleships could be readily equipt with huge channel-iron wheels to ride over land; we have also shown how 45-foot big-wheeled steel monsters, steered by gyroscopic means, could be used to run over the enemy's artillery, grinding it into the ground. And such monster machines would be practically immune to enemy shell fire on account of their high speed. The construction of these machines being largely open iron-channel work, even a direct shell hit would not do much damage, beyond ripping out a few steel pieces.

Strange to say, monsters of this kind would claim little toll of life; if you see such a juggernaut of death heading your way, you simply sidestep it! Such machines are not designed to kill; they are used solely to destroy the enemy's guns, or putting them out of action.

Now the point we wish to make is that men alone will not win the war for us. *The big machine is the thing.* One such monster replaces several thousand men. The nation that can build the largest buildings on earth, that has the greatest mechanical resources of the Allies, can easily build these comparatively simple machines. They are feasible from an engineering standpoint. Most important of all, such machines can be readily sent to France knocked down. Five hundred of them could be sent to France with the same amount of tonnage it takes to send over 25,000 of our boys. Five hundred big monsters might decide the war for us quickly; 25,000 men are a mere trifle in this war—they do not begin to make an impression.

A few weeks ago, if we had proposed a gun that could shoot 74 miles we would have been laughed at scornfully. It would have been one of our "pipe dreams." The trouble with us Americans is that we don't "dream" enough, while the Germans outdream us.

And if we do not get the big machines over to France soon, the Germans will surely beat us to it. Let us wake up.

H. GERNSBACK.

The **ELECTRICAL EXPERIMENTER** is publisht on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $1.50 a year in U. S. and possessions. Canada and foreign countries, $2.00 a year. U. S. coin as well as U. S. stamps accepted (no foreign coins or stamps). Single copies, 15 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., INC. If you change your address notify us promptly, in order that copies are not miscarried or lost. **A green wrapper indicates expiration. No copies sent after expiration.**

All communications and contributions to this journal should be address to: Editor, ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

ELECTRICAL EXPERIMENTER. Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered U. S. Patent Office. Copyright, 1918, by E. P. Co., Inc., New York. **The Contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.**

The ELECTRICAL EXPERIMENTER is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris.

'LEARN BY DOING'

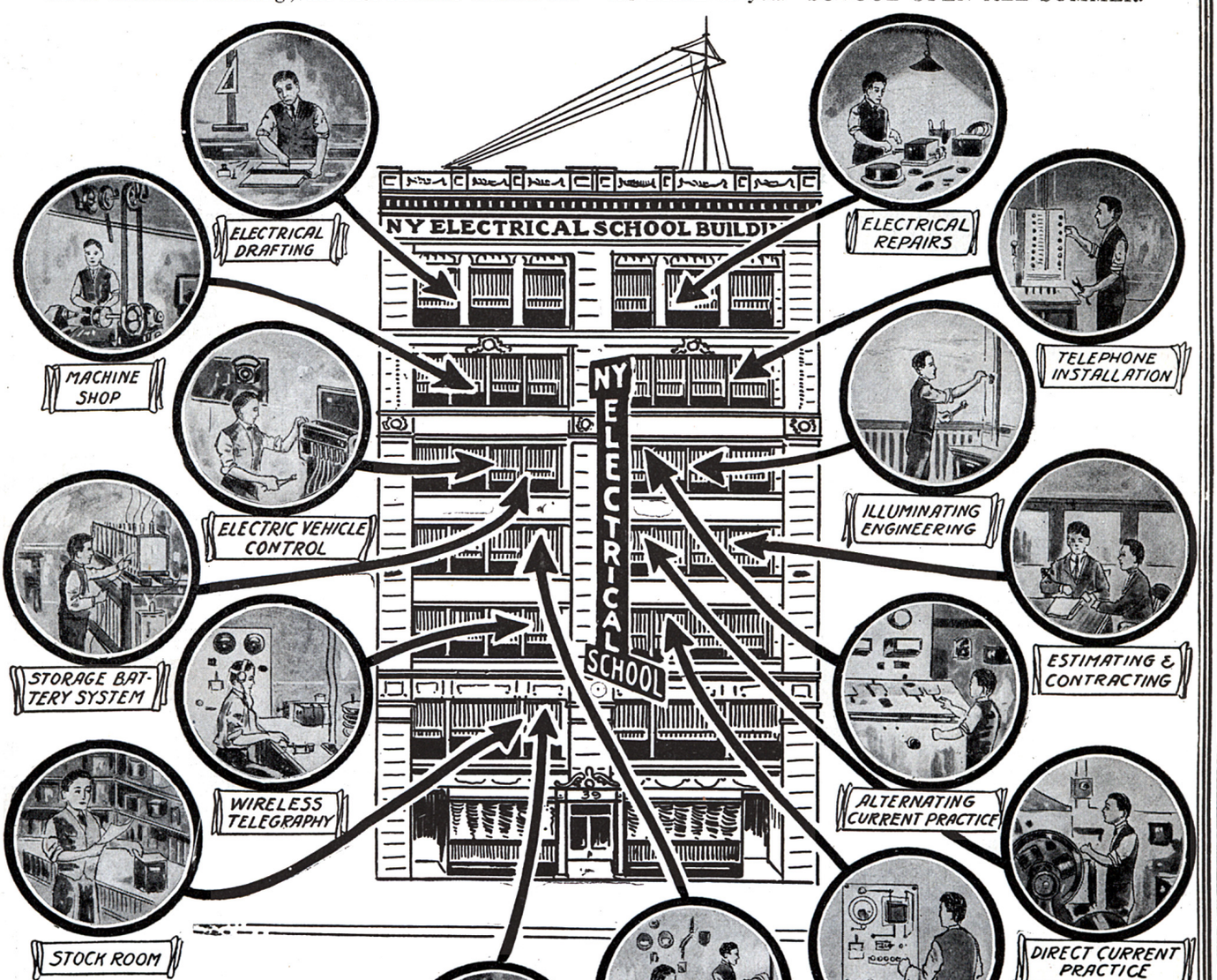
The Only Way to Learn Electricity

The only way you can become an expert is by doing the very work under competent instructors, which you will be called upon to do later on. In other words, *learn by doing*. That is the method of the New York Electrical School.

Five minutes of actual practice properly directed is worth more to a man than years and years of book study. Indeed, Actual Practice is the only training of value, and graduates of New York Electrical School have proved themselves to be the only men that are fully qualified to satisfy EVERY demand of the Electrical Profession.

At this "Learn by Doing" School a man acquires the art of Electrical Drafting; the best business method and experience in Electrical Contracting, together with the skill to install, operate and maintain all systems for producing, transmitting and using electricity. A school for Old and Young. Individual instruction.

No previous knowledge of electricity, mechanics or mathematics is necessary to take this electrical course. You can begin the course now and by steady application prepare yourself in a short time. You will be taught by practical electrical experts with actual apparatus, under actual conditions. 5,000 of our students are today successful Electrical Practitioners. Come in and read their enthusiastic letters. Let us explain this course to you in person. If you can't call, send now for 64-page book—it's FREE to you. SCHOOL OPEN ALL SUMMER.



New York Electrical School
29 W. 17th St., New York, N. Y.

Please send FREE and without obligation to me your 64-page book.

Name .....

Address .....

NEW YORK ELECTRICAL SCHOOL
29 W. 17TH ST
NEW YORK, N. Y.

Electrical Experimenter

H. GERNSBACK - EDITOR
H. W. SECOR - ASSOCIATE EDITOR

Vol. VI. Whole No. 61 | MAY, 1918 | Number 1

Electricity and Camera Give 3,000,000 Shells Third Degree

HAVE you ever stopt to think just how the experts of the ordnance department of our own as well as foreign governments manage to check up the huge quantities of cannon shells shipt to the front? Possibly not, when the accompanying photos will give some idea of the extremely fine electrical precision apparatus employed for the purpose, as well as the method used for safely firing faulty shells.

The photo at left illustrates the delicate electric chronograph, a highly sensitive and accurate electrical instrument used for recording the speed of shells in flight. This instrument showed the ordnance inspectors of the Russian Government that they were sending shrapnel shells thru the air at the rate of 1,950 feet per second!

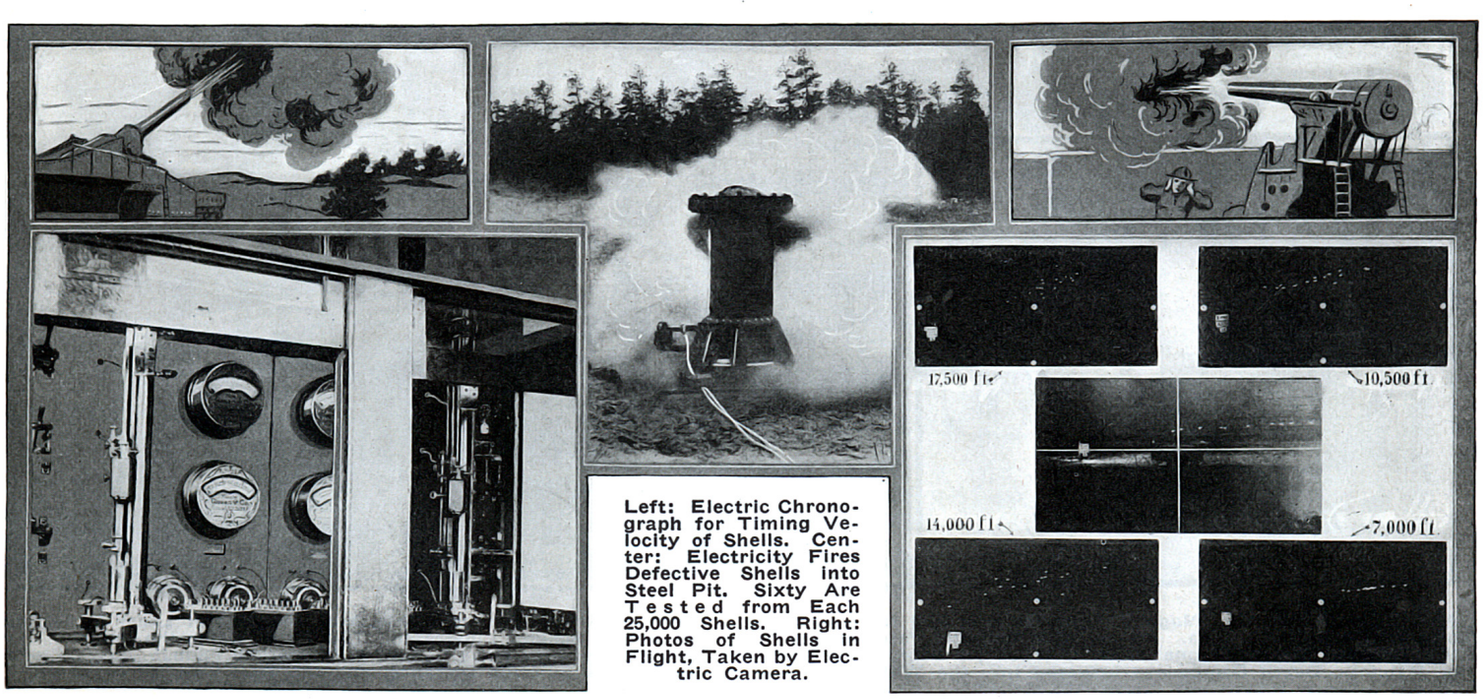
These photos are all taken of a Russian test on American-made ammunition conducted at Lakehurst, N. J., where over 3,000,000 shells were tested. Each shell could not, of course, be tested so the inspectors satisfied themselves with checking up sixty shells from every 25,000 produced. If one shell when fired failed to register properly on the photo taken by the electrically operated camera, the whole lot of 25,000 shells was immediately returned to the manufacturer.

The electric chronographs or split-second clocks used in timing the velocity of the shells when fired, are connected up to a net-work of electric wires placed at certain predetermined intervals along the proving range. Briefly explained the operation of the velocity test is as follows: As the bullet or shell leaves the muzzle of the gun it strikes one net-work of electric wires, severing one of the wires, which causes one of the electrically controlled split-second chronographs to be immediately actuated. The shell speeds on for say a thousand yards or so, depending upon the test and size of shell, when it strikes another net-work, severs a wire, opens the circuit of a second split-second chronograph and the deed is done. It is evident that by checking up the difference in time between the two (or more) chronographs and knowing the distance the shell traveled between both clock actuations, that the velocity of the shell in feet per second is at once determined.

The steel pit at center, shown here, is for exploding shells that have failed to go off when fired. The shells are recovered by "shell scouts" on the range and are fired off electrically by the officer in charge.

Photography played an important part in testing the 3,000,000 Russian shells at the Lakehurst proving grounds. It is said to be the first time that the electric camera was ever used in this country to determine the velocity of projectiles.

Right photo shows five of these remarkable instantaneous photos of shells in flight. These views show shells photographed in flight at different ranges in *versts* Russian measurement (one verst is 3,500 feet). Note the tiny dot lights at the bottom, right, left and center of each picture, also the cross-lines in the center photo, which are sometimes used to check the grouping of the shells while in flight as well as the area covered by bursting shrapnel. Shells to pass inspection have to show on the plate within the space marked by the right and left lights. The electrically controlled camera proved more trustworthy than the stop-watch. These twenty shells past the test. Similar instruments are in use by the U. S. Government experts.



Left: Electric Chronograph for Timing Velocity of Shells. Center: Electricity Fires Defective Shells into Steel Pit. Sixty Are Tested from Each 25,000 Shells. Right: Photos of Shells in Flight, Taken by Electric Camera.

Locating and Destroying "Subs" with Electro-Magnets

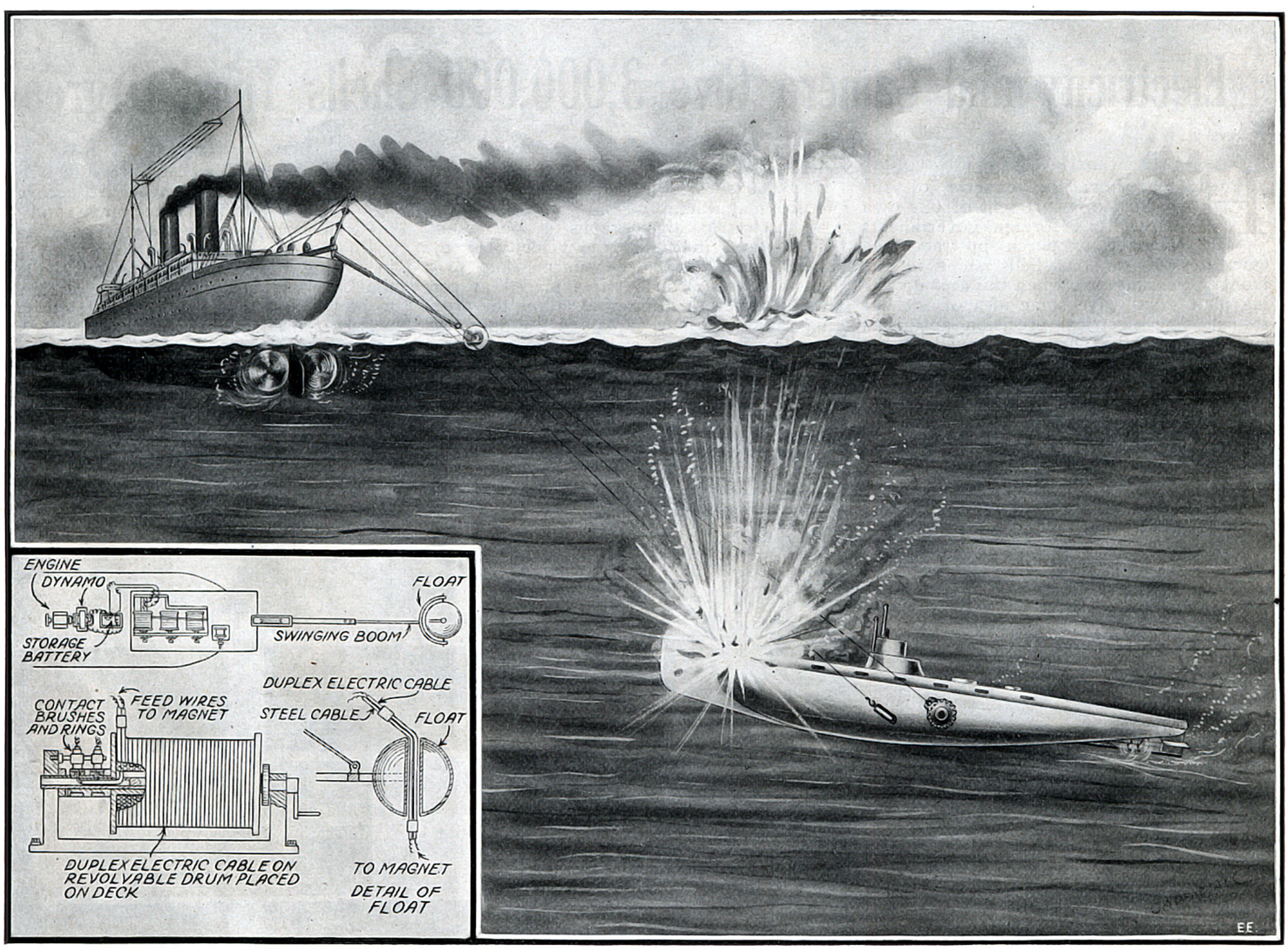
THERE'S one thing certain about this war anyway, and that is that there will be no falling off in the business of the patent office. Not if the Yankee inventors can help it, at any rate. For one thing they will be able to keep the patent examiners busy on anti-submarine devices for several years to come, apparently. We thought that the magnet schemes for combating the U-boat menace were about exhausted—we said "thought," but here's a new one. And it employs electro-magnets—oodles of them if necessary. The inventor of this newest magnetic "Sub" thru the danger zone, so that a large area may be covered in a predetermined time. A substantial base is secured rigidly upon the aft deck of the vessel as shown in the illustration herewith. This base preferably extends beyond the line of the hull, as it is upon this base that most of the working parts of the device are mounted.

Pivoted at the rear end of the base is a rearwardly projecting, vertically swinging boom which is by preferance extensible and retractable, set screws or clamps being provided for holding it in adjusted position. The rear end of the boom is forked as shown, and a suitably shaped float is mounted pivotally in this fork, the float having formed there thru a guideway thru which a suitable steel cable and an electric wire cable pass slidably and at intervals are secured together by suitable clips, these clips being preferably disposed at predetermined points so that they may be provided with indicating members whereby the depth at which the magnet is located, may be readily determined, the magnet being carried by the lower end of the steel cable and supplied with electric current from the duplex electric cable. This current is supplied to the cable from a storage battery at any suitable point on the ship, a generator being provided for charging the battery to the required extent. The generator may either be driven from the internal mechanism of the ship, or from an individual motor or engine.

The two cables attached to the electro-magnet are wound upon a drum suitably mounted upon the deck base, the anchored ends of the duplex electric feed cable, being past thru the hollow shaft of the drum and secured to a pair of contact rings which are insulated from the shaft, that is the two wires which comprise the feed cable, are secured to the brush rings. Suitable brushes contact with the rings, and current conducting wires lead from these brushes to the battery. It will thus be obvious that no matter how much the cables are wound or unwound, the current supply of the magnet will always be constant.

Any preferred means could be employed for raising and lowering the boom, but for illustrative purposes there is shown a special cable secured at its outer end to the free end of said boom, and wound at its other end on a winding drum mounted on the base.

(*Continued on page* 66)



As a General Rule the "Magnet" Schemes Proposed for Combating Submarines Are Worthless. This One Possesses at Least Some Semblance to a Practical Idea. An Inventor Recently Patented the "Magnetic Bomb" Scheme Illustrated. The Vessel Using the Device Trawls the Powerful Electro-Magnet Astern; When Its Cable Pulls Taut the Crew Knows They Have Landed a Submerged "Sub." Extra Electric or Magnetic Depth Bombs Are Lowered Into the Water, the Ship Moves Away a Suitable Distance, and the Rest Can Be Imagined.

destroyer is Mr. John A. Gault of Lancaster, Wisconsin, and the *modus operandi* of his arrangement is as follows:

The invention has for its object to provide efficient means whereby submarines may be *located and destroyed*, the invention consisting briefly of an electro-magnet, towed by means of a cable, beneath and in rear of a vessel, for locating submerged objects such as submarine vessels and mines, and *means for lowering a bomb* to destroy the submerged object when it is once entrapt by the magnet. The ship using this apparatus is preferably of the screw-driven type and driven as fast as practicable

Yankee Code Not So "Bloedsinnig"

WITH the American Expeditionary Army, France.—"I'll be in Oregon at 3. At 4 o'clock I'll be fixing up that ration question with Hindenburg in London. And if you want me after that I'll be over in Tallahassee. Just ask for the Kaiser."

Not a quotation from the ravings of a mad man—nor "balmy in the 'ead," as our British friends are wont to call the chap who is a bit "loco" in his "attic."

The foregoing conversation is just one end of a typical 'phone talk on the front where everything is "code."

The young divisional supply officer was about to leave on a round of the fighting points on the front. He was giving one of his subordinates instructions over the phone on how to reach him in case of need during the remainder of the afternoon.

"Oregon" is an artillery post a few kilometers from headquarters—not the Western State where the apples come from. Hindenburg is a battalion commander whose right name may be Smith, and London is a dugout in the support line "up front." After that he was going to a brigade headquarters. On the 'phone he answers to the name of "The Kaiser."

It's simple if you have the key, but a crazy confusion of far flung places and irreconcilable names if you don't know what they're talking about.

This "code" is a safeguard against enemy "listening-in" sets. By means of induction —stringing wires parallel to our trenches, tho 50 yards away in "No Man's Land"— the wily Germans often pick up the Yankee talk over the wires. It therefore becomes plain that if a Boche listening post picked up that message the observer scanned his maps of the sector in vain for "London" and "Tallahassee." And "Hindenburg"— there's only one Hindenburg and he isn't visiting London these days to consult on rationing problems. Every loyal Boche knows that. The "bloedsinnige" (idiotic) Yankees must be mad.

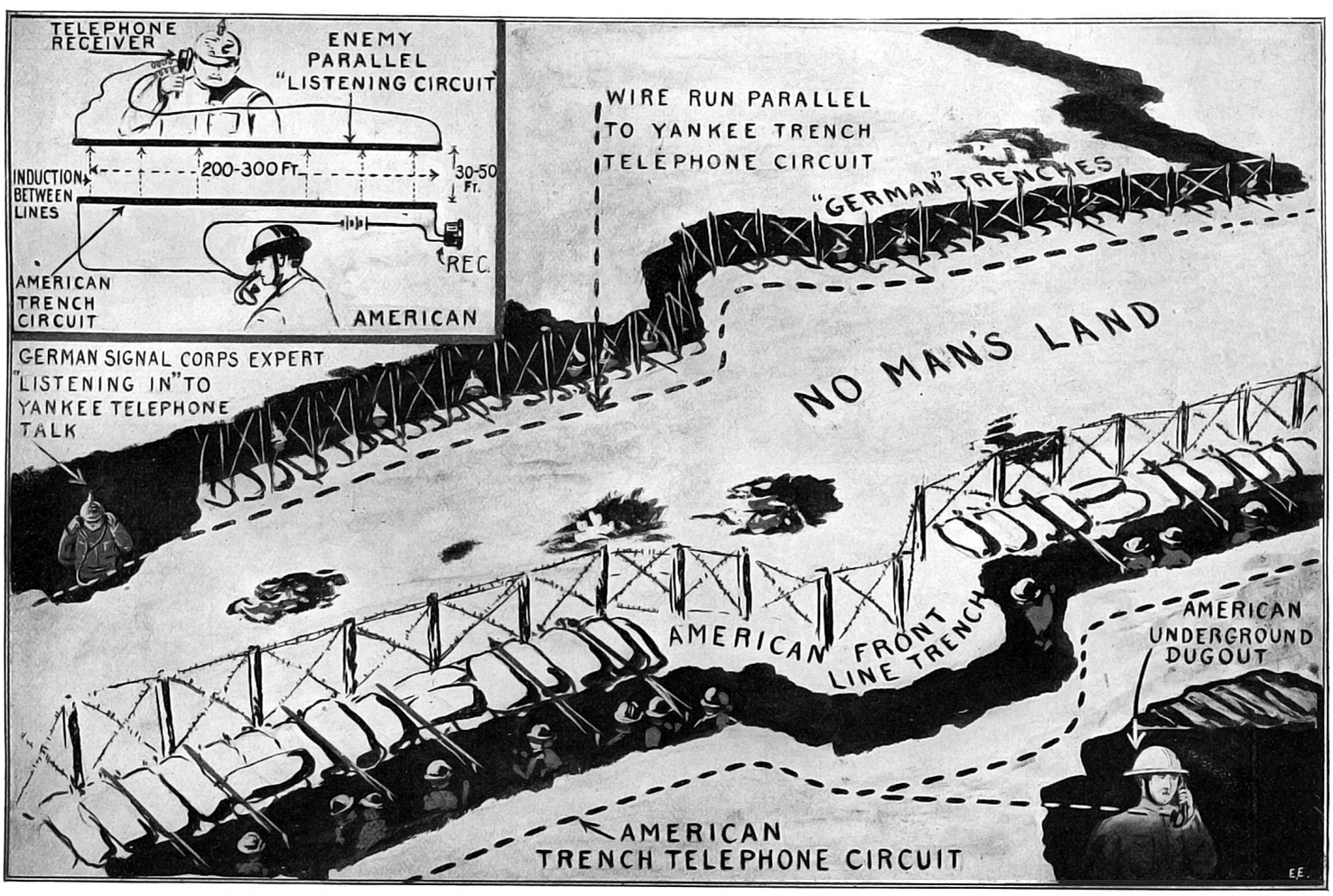
It is an interesting fact that where telegraph and telephone circuits or multiple telephone circuits only lie near each other for any appreciable distance then such circuits are subject to electro-static inductive effects, which produces what is technically called "cross-talk." Telephone circuits are transposed to obviate this difficulty in practise.

In one instance it was found (see Sewall's *"Wireless Telegraphy"*) that where a wire was run along parallel to a telephone circuit for 300 feet and at a distance of 30 feet on the average, the "talk" could be heard in a telephone receiver connected in the separate "listening circuit." In the early days of telegraphy great trouble was often experienced by "cross-talk" between long distance circuits when they happened to be parallel one another for any appreciable distance. Inductive effects were manifested between the telephone cables leading from New York City to Saratoga, N. Y., and Providence, R. I., due to the proximity of these two circuits in New York City.

The insert detail here shown gives the simple arrangement necessary for listening in by induction to conversations in a certain telephone line. The listening post of the enemy may moreover be equipt with powerful amplifiers to intensify whatever messages are intercepted. Ordinarily it is only necessary to connect up a telephone receiver to the single "paralleling" wire. This is usually a simple matter, as the trenches frequently run nearly parallel for considerable distances. The listening wire should, of course, be insulated and part of it might be camouflaged or hidden in the dirt of "No Man's Land," so as to reduce the distance between the two circuits, and thus increasing the inductive effect. In some instances the telephone lines have been but a few feet apart.

An early American radio-worker, one Amos E. Dolbear, invented and patented an inductive telephone and telegraph system and actually made it "talk" one-half mile. His patent was issued in 1886, but owing to the limitations of such a system

(*Continued on page* 66)



Every Now and Then the Press War Reports Contain the Statement That the Enemy Has Been Caught "Listening In" to Telephone Conversations, or Also That Enemy Telephone Lines Have Been "Listened In" On. Here's the Way It Can Be Done—Purely By Electrostatic Induction, Without Any Metallic Connections Between the Two Circuits. It is a Well Known Phenomenon to all Telephone Men.

New Spy and Scientific Movies

By GEORGE HOLMES

THERE seems to be no dearth of interesting photoplays, especially among those that depend on science to attract theater patrons. One film-play in particular is very much in the limelight at present, being the exposé of numerous plots against the United States even before we were drawn into this great world conflict.

Written by that celebrated authority, Wm. J. Flynn, late retired chief of the U. S. Secret Service, the drama under the title of *"The Eagle's Eye"* leads one thru a series of episodes which show the despicable methods and plots originated to wreak vengeance and hamper as much as possible the work of beating the "Hun"!

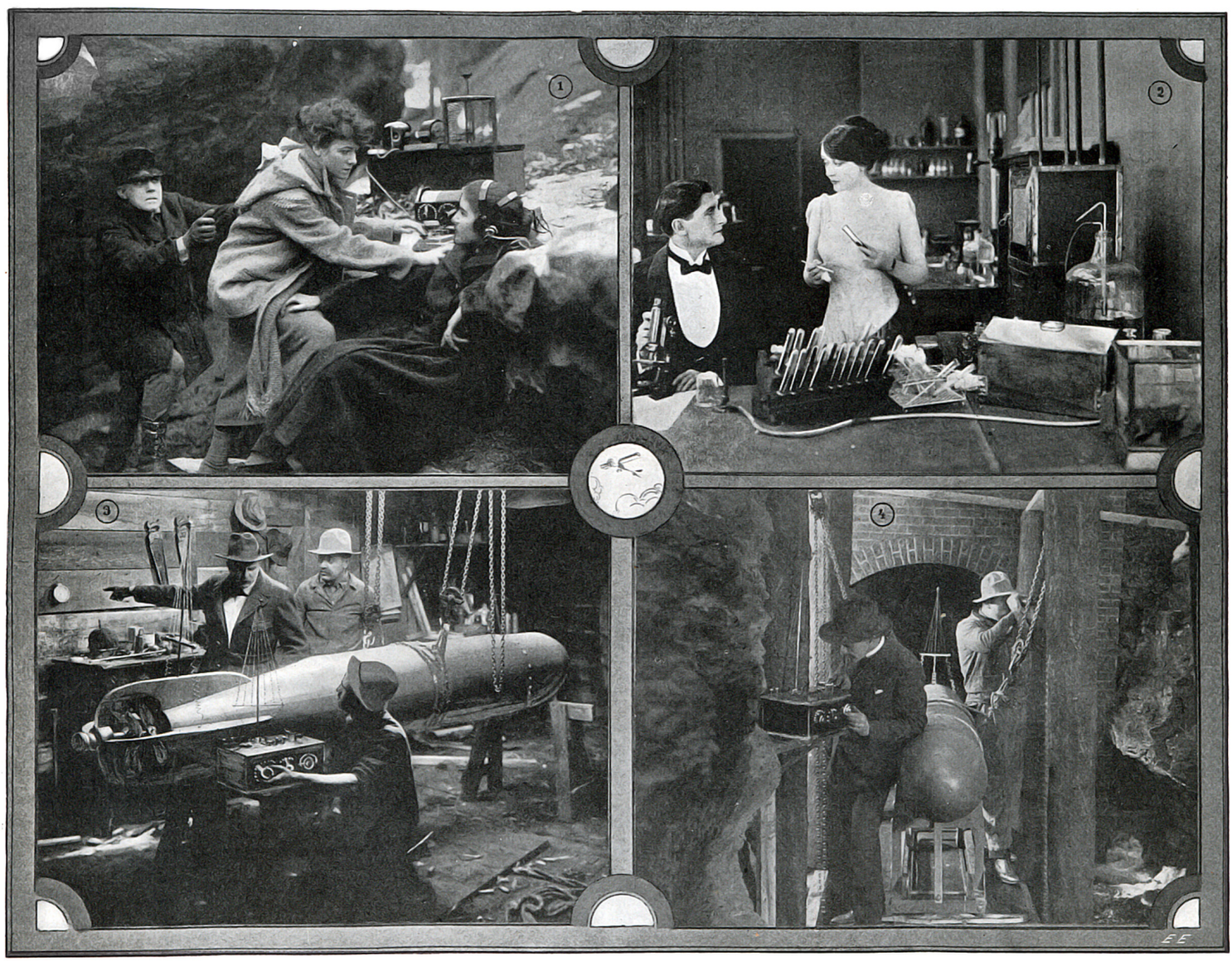
Two of the photos show a specially built wireless-controlled torpedo which the Imperial German Government made in this country for the destruction of the flagship of the Atlantic Fleet as it was leaving New York Harbor after the review of 1915. Also there may be seen a compact land radio set tuned with the apparatus on the torpedo, so that perfect control may be had.

Another photo shows an exciting scene in the sixth episode of *"A Daughter of Uncle Sam."* Jessie Emerson (Miss Jane Vance) has just been captured by a band of German spies and taken to their headquarters in an abandoned cave on the New England coast, where they propose to force her to reveal the secret of a marvelous war invention perfected by a lieutenant in the United States Army. Jessie pretends to faint and while her guard rushes for aid she makes her way to the wireless instrument in the cave and sends out a call for help. The ruse is detected and she is overpowered, but not before the operator who has taken her place at the Government station has picked up the brief message. The unfinished call for help is turned over to the army authorities, and soldiers are ordered to scour the community in search of the possible hiding place of the gang.

The last photo is a laboratory scene from *"The Light Within,"* a recent Petrova photo-play feature. Mme. Petrova, the famous Polish star, plays the part of Laurel, a doctor's daughter, who, in order to get money to complete her father's scientific researches, marries a wealthy man she doesn't love. A son is born to the couple only to become a barrier between them. The husband leaves for a long sea trip, is reported lost, but turns up at home just in time to see Laurel promise herself to Richard Leslie, a young doctor she had loved before her marriage. The death of their son embitters Durand, the husband, and he plans a revenge as fiendish as it is novel.

He pretends a deep interest in the young doctor and thru various pretexts throws the pair together on every conceivable occasion. Laurel finally discovers a serum for the cure of the deadly anthrax germ thru the medium of the mascarine turtle. She possesses but one small specimen of the turtle, the only other one being the property of the city Zoo. Supremely confident of the serum, she decides to demonstrate the efficacy of her cure for anthrax by inoculating herself with the deadly poison. Young Leslie begs her to use him

(*Continued on page* 66.)



War Plots, Science, Mystery—All Are Dished Up in Profusion in the Newest "Movie" Dramas. Fig. 1—A German Spy Radio Station in the Mountains, from "A Daughter of Uncle Sam." 2—The Chemical Laboratory in Olga Petrova's "The Light Within." Figs. 3 and 4—A New Radio-Controlled Torpedo Built by German Spies in America, from "The Eagle's Eye."

Electricity and Metal Coated Seeds Boost Crops

ELECTRICITY at high potentials has been used heretofore in an effort to stimulate the germination and growth of plant life, particularly those of a food-bearing nature. Several English experimental farms have been trying out such schemes with more or less success, but apparently the method used whereby several hundred thousand volts of high frequency current is caused to "leak off" an elevated wire net-work to the plants themselves, left considerable room for improvement.

This improvement seems to have been made by a Chicago, Ill., genius, Mr. Robert D. McCreery, who has provided a truly novel scheme whereby the high potential, high frequency currents do not have to traverse several million ohms of "air resistance" before reaching the plants, but are enabled to pass thru the earth directly to the roots of the growing plants or to the seeds undergoing the process of germination. An increase of 30 per cent and more was attained in the crop production as proved by actual "growing" tests.

"Electricity," declares Mr. McCreery, "unquestionably stimulates seed germination and subsequent plant growth. Electricity in the soil causes larger crops and healthier plant life. With the end in view of stimulating food crops in England at a time when the submarine menace was the gravest, the Government devised the plan of stringing wires across the fields and causing them constantly to disseminate an electric current.

"Undoubtedly more electricity is *lost in the air* than is brought into contact with roots of the growing crops. The new system aims to eliminate this waste. By employing it the electricity is diffused directly into the ground, where it is brought into contact with the metallic element covering the seeds. High frequency electricity always seeks out the points of lowest resistance. These are my metal coated seeds.

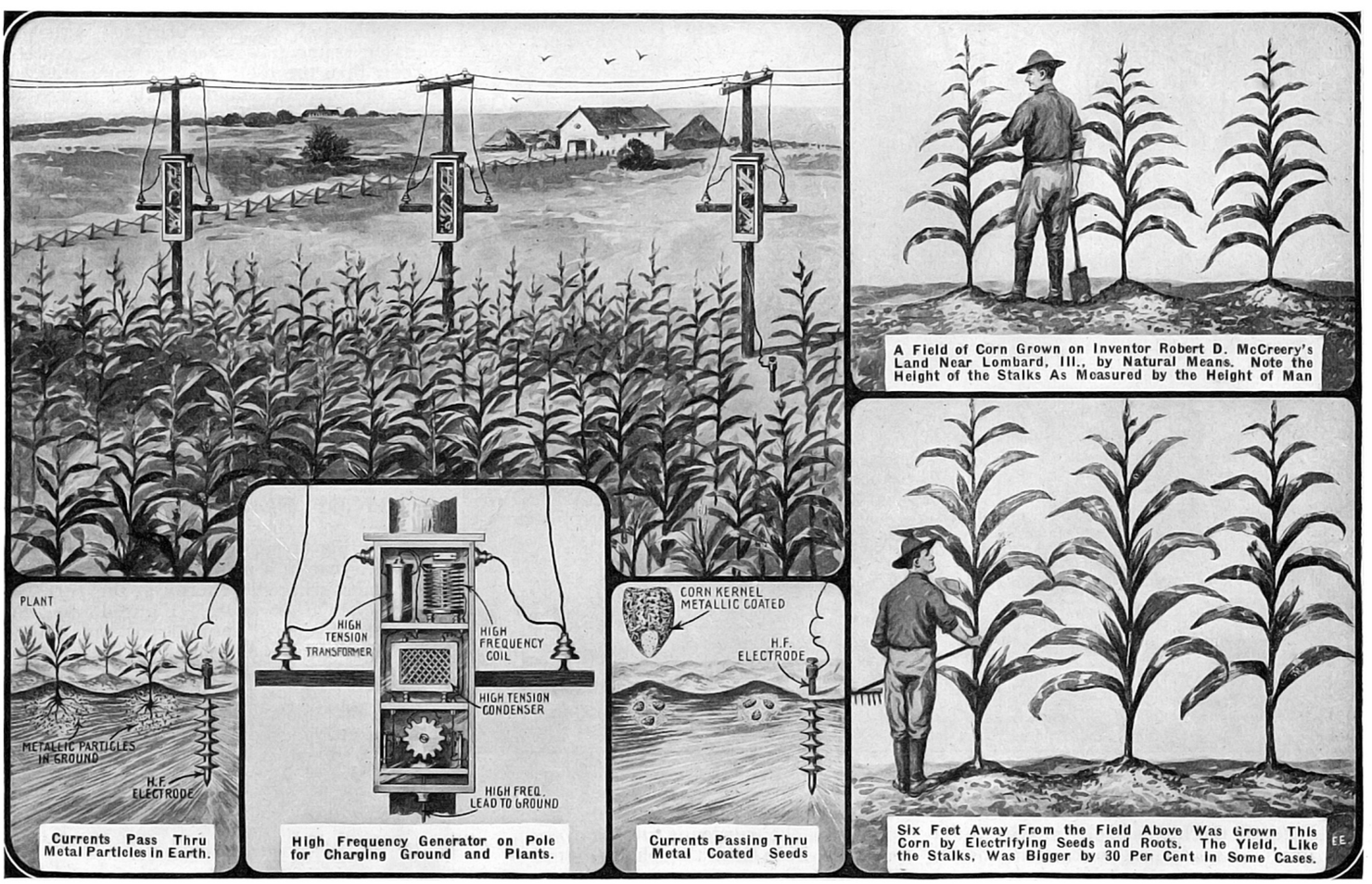
"Electrodes are set at the opposite ends of the field or garden plot and electrically charged. They serve to spray electricity thru the ground devoted to the growing of the crop to be so treated. In order that the juice may reach its proper objective the seeds or shoots are surrounded with a metallic element. With ordinary seeds this can be done in large quantities and in a very few minutes. Indeed, the process is so simple that a farmer's lad operating it can coat enough seed corn in ten minutes for planting twenty acres of corn.

"The control of the electricity is brought about by metallically coating the seed with a finely divided non-deteriorating metal before planting, thus creating lines of low resistance, since high frequency waves are automatically drawn to anything metallic. (See detail drawings in illustration herewith.)

"After the germination of the seed—which is both hastened and assured by the electrical treatment—this metallic element continues to inhere in the roots of the plant and absorb more current, thus establishing a continuity of the system."

The idea of metallically coating the seed does not debar its use for such garden products as are grown from sprouts or from portions of the parent plant, as is the case with potatoes, celery, etc. McCreery declares that the electrical treatment will be wonderfully effective in growing garden truck.

"Where the electric system is used," he explains, "it is necessary that the individual plants have the metallic element previously alluded to. But this need not be a part of the seed itself. In fact, for certain plants it is just as well that the ground immediately around them be impregnated with the metallic property. (See illustrations.)



Copyright by E. P. Co.

"In the growing of asparagus or celery it is only necessary that the hills contain some of the mineral. In any event, the metallic coating does not exclude the absorption of moisture or in any way interfere with normal growth processes save in the direction of hastening and strengthening them."

Only a bed of minerals beneath the garden would defeat the projected action of the electric current, says McCreery. A bed of iron ore lying within a few feet of the surface would undoubtedly deflect the electricity. This contingency, however, is a negligible one, save in a few regions where the soil is strongly impregnated with minerals.

The efficiency of the treatment, it seems, is better known in relation to its results than in the actual details of its workings.

(*Continued on page* 66)

The Electro-Magnet in the Operating Room

By S. GERNSBACK

IN a modern war hospital, the electro-magnet is playing a big rôle nowadays. It is practically impossible to thoroly clean wounds of shrapnel splinters without the use of this practical apparatus, as in many cases these particles are included by the dozens in the human body and it would be a great loss of time to the surgeon as well as pain to the patient, if each fragment had to be located and extracted separately.

When the wounded soldier is brought to a base hospital, all the big iron fragments are easily located, and are removed by hand and forceps. After this first operation a thoro research for small splinters is made, with the aid of a strong electro-magnet.

But that the electro-magnet should be in every hospital, ready to be used at any moment, is shown by the accompanying illustrations.

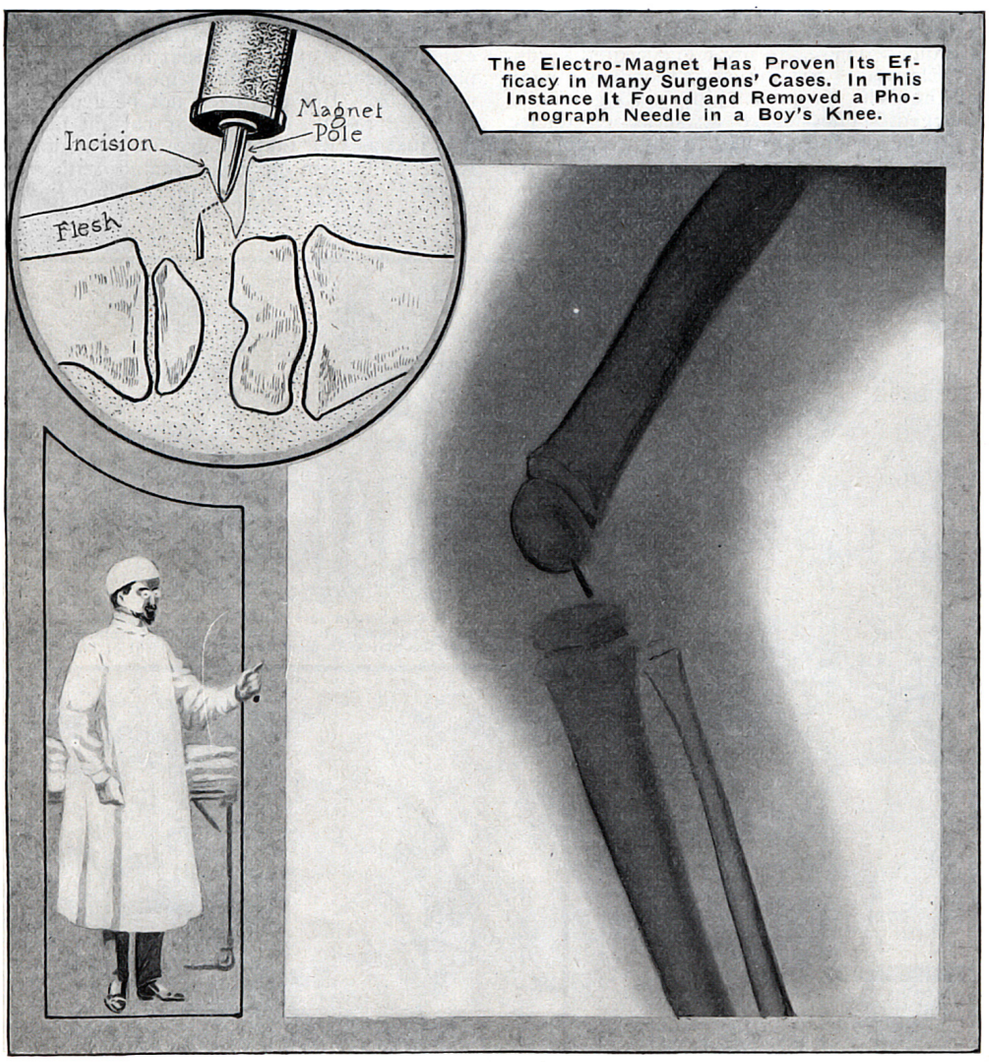
Some time ago a young boy was brought to a hospital in New York City on account of a swelling of the knee and excruciating pains in the same.

An X-ray examination showed that the patient had a phonograph needle imbedded deeply in his knee.

The needle must have worked itself into the patient's knee, a boy three years of age, while creeping on the floor. It was decided to remove the needle by an operation.

Altho there was a front and side view X-ray taken, to ascertain the exact location of the needle, the surgeons at the beginning of the operation could not find the object and finally called for an electro-magnet.

After applying the current, the magnet was brought in the incision made by the surgeons in the patient's knee and the phonograph needle was extracted at once and clung to the pole piece of the magnet.



The Electro-Magnet Has Proven Its Efficacy in Many Surgeons' Cases. In This Instance It Found and Removed a Phonograph Needle in a Boy's Knee.

DENTISTS TEST NERVES NOW BY ELECTRICITY.

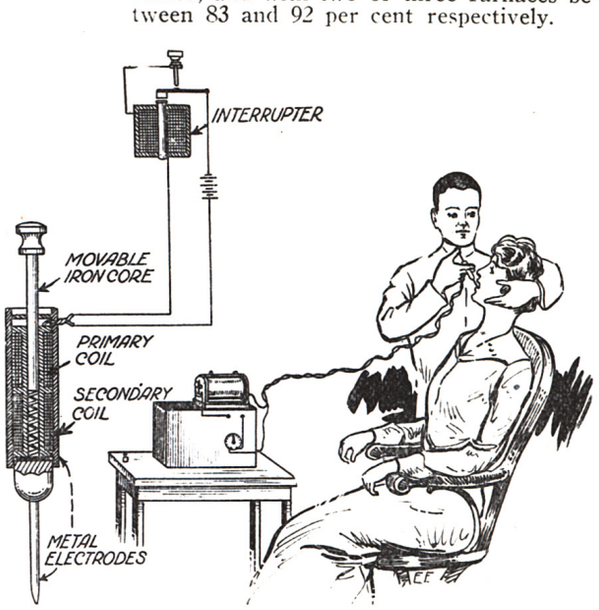
It frequently happens that the nerve of a tooth dies, even when the tooth is apparently sound, without giving any external indication. This almost universally results in an abcess in the bone structure at the end of the root of the tooth, which abscess may not give any local pain or external indication of its presence and may exist unknown for years. During this time the pus continuously formed in the abscess is absorbed into the system and may cause various ailments, such as rheumatism, heart disease, kidney disease, etc., all really due to the pus carried by this dead tooth nerve but often attributable to other causes. The dentist may have examined the tooth many times during this period and found nothing wrong, because of the absence of any external signs.

It is the object of the invention here illustrated to provide an electric nerve-testing instrument, by which the dentist may determine absolutely whether or not the nerve of a tooth is vital. It was invented and patented by Mr. Arthur R. Darling, of Indianapolis, Ind. The instrument is provided with a probe of conducting material of suitable form to engage the tooth, and this probe has associated with it an induction coil with a variable-reluctance magnetic circuit, interconnecting the primary and secondary coils. When the dentist presses on the center rod as shown, the induction coil core is pushed in and the reluctance reduced, thereby increasing the voltage of the secondary winding of the induction coil. The secondary of this induction coil has one terminal connected to the probe and the other provided with any suitable connection whereby the secondary circuit thru the tooth may be completed, as thru the dentist's hand, which is placed in contact with the patient's face or neck. Preferably the make and break device for this induction coil is separate from the instrument, to avoid vibration in the instrument.

In testing the teeth the dentist grasps the instrument in the manner shown, pushing down slowly on the center core plunger which raises the secondary voltage, and hence the strength of current applied to the tooth and nerve. If the nerve is dead, the dentist can push the central core rod entirely into the spool and the patient will feel nothing in the tooth being tested. If the nerve is vital, the patient feels the current in the tooth before the rod has been pushed in very far. A whole set of teeth may be tested in a few minutes.

COST OF ELECTRIC PIG IRON.

Based on experiments at Trolhättan, 4 tons of pig iron should be produced per kilowatt-year in a plant using only one furnace, measuring the energy at the furnace, says *The Electrician*. Figured on the amount of energy purchased, the output should be about 3.32 tons per kilowatt-year. Better results may be expected from a plant of two, or three or four furnaces. With a plant of four furnaces, it is assumed that an efficiency of 92 per cent can be attained, and with two or three furnaces between 83 and 92 per cent respectively.



A New Electric "Nerve Tester" for Dentists Recently Patented. The Current Thru the Nerve Can Be Increased as Desired. Dead Nerves Give no Response.

ENGLISH USE MICROPHONE TO FIND U-BOATS.

Two of the methods by which the British are effectively fighting the German submarine are by the use of new microphone detectors and explosive bombs of enormous power, according to a writer in the *Tidningen,* an authority on technical information.

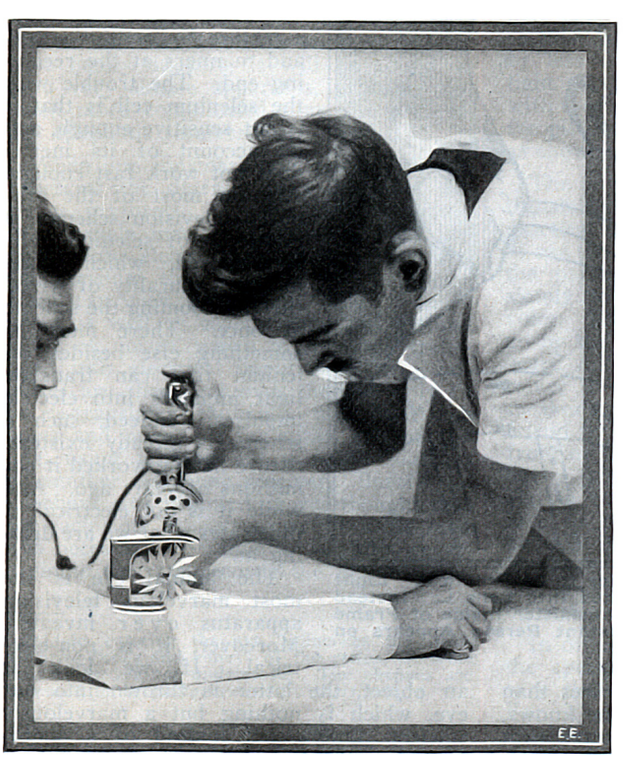
English experts have so improved the use of the microphone on anti-submarine vessels, says the writer, that they are able to steer accurately and automatically down on the submarine, while formerly they were unable to locate a vessel beneath the surface. The microphones are placed below the water close to the keel of the vessel, and answer the same purpose as the microphone of a telephone. By listening to the beat of the submarine's propeller they can determine the exact location of the enemy and attack him before he has the slightest idea of what is happening.

The detection instruments used with the microphones are very complex. One of them shows the distance of the submarine on a graduated scale, the indicator responding electrically to the sound from the submarine's propellers. The variations of distance are shown with marvelous accuracy. Another device shows whether the enemy is on the port or starboard side. The electromagnetic needle moves to the side on which the sound is loudest and the ship is guided accordingly.

When the proper spot is reached bombs are dropt in the same manner as from airplanes. Their under-water force is so great that they can destroy a submarine 150 feet from the point of explosion.

ELECTRICITY AS A TRENCH DIGGER.

It is reported that the French are making extensive use of electricity at the front in the operation of all kinds of excavating machines. Working in ordinary earth, four men with two wheelbarrows and a machine driven by an electric motor can shift from twenty-five to thirty-five tons a day. In a month a shelter with sleeping accommodation for 500 men can be dug by a single company.



A New Electric Appliance for Our Army Surgeons Is This Rapid Plaster Cast Cutter. A Motor-Driven Blade Does the Trick.

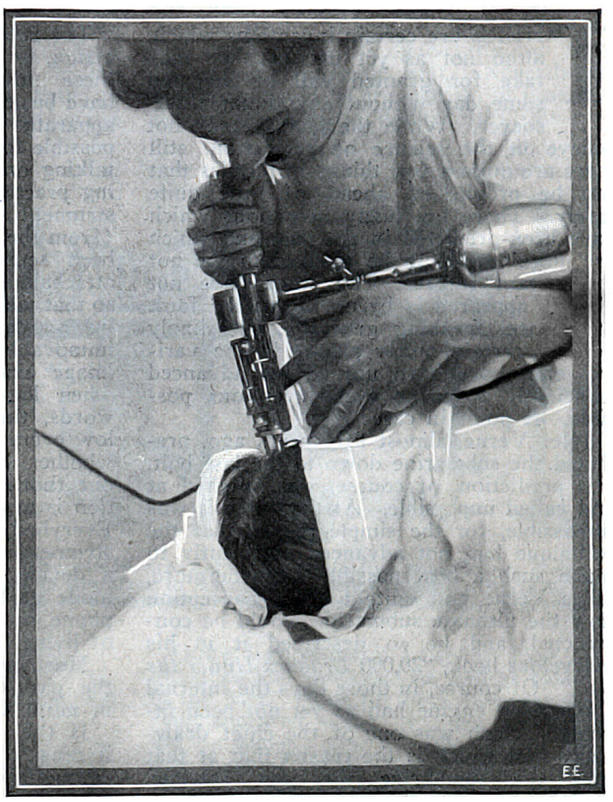
Zip! Goes the Motor and Plaster Cast is Off

The doctors and nurses are right on the job in the present stirring times, when it comes to having electrical devices and refinements. If you think the soldiers and sailors have a mortgage on the "juice" operated inventions with which to push the "Hun" back across the border—well, guess again.

Ever see the "Doc" cut a plaster-of-Paris cast loose from a wounded patient? Yes, it was an awkward job at best. But now the electric cast cutter severs the encasement in one clip. It is provided with a special saw over a plate which slips under the cast as shown.

The Medical Corps is doing everything in human power to comfort our injured boys at the front thru the instrumentality of new surgical instruments.

When it is required to repair a part of a broken skull the new motor-driven drilling device here illustrated will bore a hole with accurate precision, so it will not affect the tissues in the head. Such operations are often necessary at the front line and base hospitals, as, for instance, when a soldier has received a heavy blow on the head. This often results in a clot of blood forming which presses on the brain, depriving the victim of a part of his faculties at least. In such cases the surgeons must trephine the skull; *i. e.,* cut out a triangular piece of the skull in order to remove the blood clot. Afterwards a silver plate is placed over the opening.



Ever See a Patient's Head "Trephined"? Here's a New Electric Drill for Repairing All Kinds of Skull Fractures and Similar Head Troubles.

TELEPHONE CONNECTIONS ON THE EASTERN FRONT.

An interesting development in methods of electrical communication between headquarters and the men in the trenches—namely, the use of wireless to a degree unexpected previous to the war is commented upon in the French journal *L'Industries Electrique.* It was formerly assumed that wireless methods of communication would be unsuitable in such circumstances, owing to the ease with which messages can be intercepted by the enemy. The tendency has therefore been to rely mainly on telephone connection, notwithstanding the ease with which this connection may be ruptured by bombardment. The destructive effect of modern artillery has made the ordinary method of laying wires along the surface of the ground or attaching them to trees of limited utility. Even buried wires are apt to be destroyed at an inconvenient moment by explosive shells, and therefore the depth at which such wires are buried has become continuously greater and the methods of protection more elaborate.

The Germans have sought to get over this difficulty by laying a regular network of interconnected lines, so that in the event of several being damaged there is still a path for the current. Even this precaution, however, may fail in a modern bombardment, and the Germans now appear to be relying to a much greater extent on wireless communication. The article in question quotes particulars which are said to apply to the latest German practise, according to which it would appear that the antenna are mounted 4 meters above the surface, are about 100 meters long and emit waves of 300 to 600 meters. On the Eastern front about 110 wireless detachments are said to be employed.

HIGH FREQUENCY CURRENTS HELP BRAIN TROUBLE.

The case of a model young woman who suffered from a mental aberration is described by Dr. S. St. John Wright in the *American Journal of Electrotherapeutics.* Some months ago she underwent a mental change, becoming morose, listless, apathetic and strange. On October 4th she declared life not worth living and would kill herself. She struck her devoted mother on the face, and acted riotously. During a lull in the excitement, they came to me, says the doctor. A severe proctatitis was found and treated by glass vacuum electrodes and the high frequency current and resorcin swab. Another slight riot occurred in the afternoon of the same day but none since. After five treatments her muddy countenance rapidly cleared. She is now herself: active, cheerful and delighted, and delighting her mother and step-father. She has resumed her music, correspondence, and domestic activities. All evidence of tenderness and pain had vanished after the second treatment. This case well illustrates the fact that mental aberrations may be due to local focal causes, and that its removal or correction at an early date restores mental equilibrium, and cheats the asylum.

COMING INVENTIONS
No. 1.

Television and the Telephot

By H. GERNSBACK

THERE are certain inventions which, altho not as yet existent, we may take for granted will be invented some day without any doubt whatsoever. While the layman may not believe in the science of prediction, still there are quite a few things in physics that can be prophesied ahead of time quite safely. There are many inventions which have been predicted in the past and which are quite certain to be realized in the not too distant future. That they have not already appeared is by no means the fault of science, speaking generally, but simply because certain minor phases in the various endeavors have not as yet advanced sufficiently to make such inventions possible. A point in case:

Jules Verne, almost fifty years ago, predicted the submarine down to the last bolt. His prediction, of course, was laughed at and called impossible. At that time it was impossible, for the simple reason that the technique had not advanced sufficiently to make such a boat possible. Furthermore, Jules Verne had quite a clear conception how the ultimate submarine would be constructed, and he so described it in his marvelous book, "20,000 *Leagues Under the Sea.*" Of course, in those days the internal combustion engine had as yet not been invented, which was one of the chief drawbacks and which is the reason that at that time the submarine was not feasible. Neither had the storage battery been invented, and Jule Verne's idea of propelling a sub-sea boat by means of primary batteries alone, while feasible on paper, was not practical.

Another case in point is that of the planet Neptune, which had never been dreamt of until Le Verrier, the famous French mathematician, in 1846, by mathematical deductions, not only predicted that there *must* be another planet beyond Uranus, but he also predicted—on paper—just where in the heavens the planet might be found. His prediction proved correct, and the planet Neptune was indeed found almost exactly in the region where Le Verrier had deducted that it must gravitate. This was one of the most astounding scientific predictions ever made, but this instance, of course, was founded upon the exact science of mathematics.

Another case in point is that we know to-day that our list of elements is not quite complete. There are several gaps as yet of certain elements which have never been seen by man. Not only do we know that there must exist such elements, but we also know the *physical properties* of them, should they be discovered some day, which no doubt they will. When we therefore make the assertion that certain inventions are coming, we make it on a safe, scientific ground, because such discoveries surely will be made without doubt.

The subject of the present article *"Television, or Seeing at a Distance,"* is one of these inventions. Numerous inventors have busied themselves trying to invent an apparatus or machine whereby it would be possible for one person to see another while talking on the telephone, but so far nothing practical has resulted. The future instrument on which the name "Telephot" (from the Greek *tele*-far, *photos*-light) has been settled, is supposedly an apparatus attachable to our present telephone system, so that when we speak to our distant friend, we may see his likeness not only as an immovable picture, but we will see his image exactly as we see our own image when looking into a mirror. In other words, the apparatus must faithfully follow every movement of our distant friend whether he is only five blocks away or one thousand miles. That such an invention is urgently required is needless to say. Everybody would wish to have such an instrument, and it is safe to say that such a device would revolutionize our present mode of living, just as much as the telephone revolutionized our former standard of living.

Most inventors who had been working in the past on this problem, failed to bear in mind a very important consideration.

If the Telephot is ever to be a success, it must of course be possible to attach it to the present-day telephone lines. That means that the instrument must of necessity work in conjunction with the telephone without necessitating any more wires than there are used now. As everyone knows, the subscriber's telephone is connected with *two* wires to the central station. Each telephone instrument therefore requires *two* wires, or otherwise one metallic wire, and the ground for a return "wire," which is the same thing as two wires. Over these two wires to-day, we do not only speak, but "Central" also rings your bell. In the case of a "pay-station" telephone, quite a few more functions are accomplished over these two same wires. It is also possible to-day to telegraph and telephone *simultaneously* over two wires neither one or the other being affected. Why then should it not be possible to also send *translated* light impulses over these two wires at the same time that the voice impulses are translated over them?

In most of the schemes offered by inventors heretofore, a plurality of wires was necessary; in some cases *several thousand pairs of wires.* No matter how well such an instrument might work, this alone would doom it to certain failure. Another point is that the future Telephot must not be a cumbersome machine requiring motors and all kinds of other cumbersome machinery, difficult to operate by the layman.

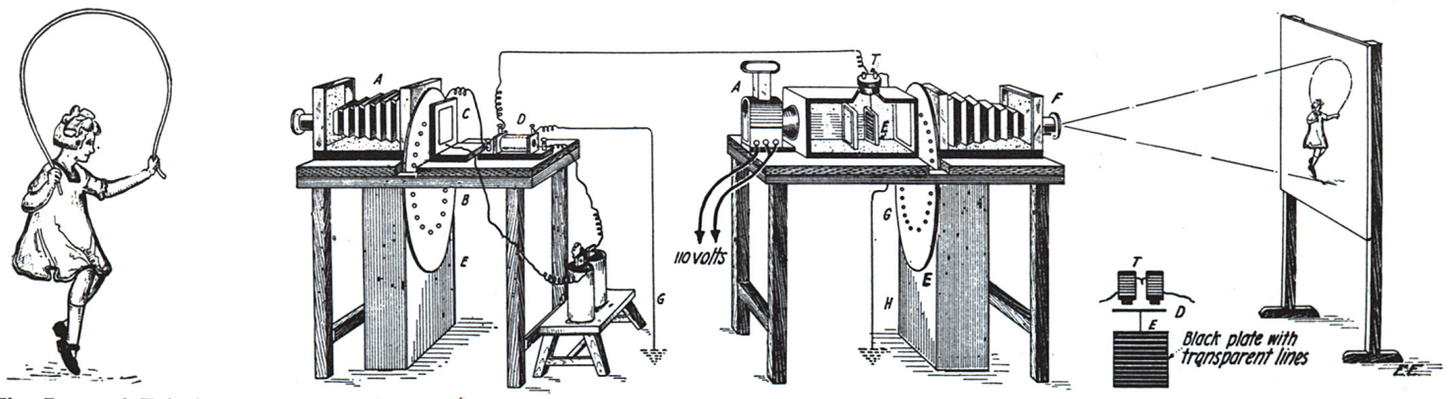
The future instrument must work the same as the telephone. In other words, all the subscriber has to do is to lift the receiver off the hook, and he will immediately see his friend just as if he were talking to him in the same room. All these requirements may seem hard on the inventor, but they are absolutely necessary as a simple reflection will show.

The writer also ventures to say that no Telephot will ever amount to anything that necessitates the use of selenium. As is well known in nearly all past suggested television schemes, the selenium cell in one form or another was used. The underlying idea of these schemes is that light rays of the object striking the selenium cell varies the resistance of the same, and these various impulses are then sent over the line to be translated into a picture by various means and manners at the receiving end. The trouble with the selenium cell is that it is not sensitive enough, and on account of its inertia does not work fast enough. Also in most of the proposed television schemes, a multitude of selenium cells is required, which again means a plurality of wires, thereby dooming the scheme at once. There must be something else besides selenium that can translate light impulses into electric impulses. Indeed, such a scheme is already existent, nature having worked it out millions of years ago. And while it is not electrical, it illustrates what we are driving at.

The animal eye is the most marvelous television apparatus ever invented. Moreover, it is non-electrical. If we look at an object, the latter is thrown into our eye, which is nothing but a marvelously efficient camera, but instead of a photographic plate, the impulses are thrown up on the *Retina* which records the object, not only in black and white as does the

What the Future Telephot Will Look Like in Order to be Practical. Light R Throws Light on Speaker's Face and is Reflected Into Lens L. Instead of a Mouthpiece, the Holes H of the Sensitive Transmitter Inside of Frame F Pick Up the Speech. The Picture of the Distant Person Appears on Screen S.

photographic plate, but the picture is recorded in its *natural colors* on the retina. From here numerous fine nerve strings interlocked in the retina connect with the optical nerve, which nerve in turn connects with the occipital lobes of the brain, *translating the various light impulses, (stimuli) with their component colors into a "picture,"* which is then "seen" in our mind. We say "seen" advisedly, because of course the picture is not actually seen in the mind, but the impulses which the vibrations so faithfully that it is possible to recognize a friend's voice readily over the telephone as is done every day; this is quite an amazing fact, if one stops to think of it. For in order to recognize a friend's voice, it is not only necessary to transmit the various sounds, but also all the overtones as well as the *timber* of the voice. Fifty years ago it would have been considered scientifically impossible if the proposition had been advanced that all this could be accomplisht by means of a will be necessary to provide a lamp *R* at the top of the Telephot, which lamp throws its rays on the speaker's face; from here the light rays are thrown onto the lens, thence to be transmitted to the distant station. It naturally goes without saying that the ideal Telephot should transmit the picture in its natural colors, altho this may perhaps be asking a little too much of our inventors at first. Nevertheless, we think it will be accomplisht in time; the human eye does it, don't forget this.



The Dussaud Telephot Uses Two Perforated Discs B Revolving Synchronously. The Holes are Arranged Helically; thus Every Point of the Picture is Covered During One Revolution of the Disc. Selenium Cell C Transmits Impulses to Receiver T, which Vibrates Plate E. The Latter Only Passes Parallel Rays of Light. With this Machine it is—Theoretically—Possible to Transmit Objects in Motion, Electrically.

retina has picked up *are translated into another form,* which we experience in turn as the sensation of seeing.*

As has been shown experimentally, the picture is retained on the retina for about one-tenth of a second. This is called the *persistence of the image.* It is this phenomenon which is made use of in moving pictures, each successive picture staying on the screen for a tenth of a second before the next one is flashed on. The fact that the pictures follow each other so rapidly, gives the impression on the retina that the objects are moving on the screen, which of course they do not.

Now, as we have shown that pictures can actually be transmitted at a distance† without the means of selenium cells, it is up to our inventors to devise something to do away with these cells entirely. It is safe to say that when the successful Telephot finally appears, it will be found to be a very simple apparatus, probably not much more complicated than the present-day telephone receiver.

When one considers how many different functions the diafram in a telephone receiver performs, it seems that it should be a simple matter to translate light impulses into electrical impulses. Just stop and consider that a single telephone diafram can pick up several hundred pure notes as well as several thousand distinct kinds of noises, which in turn are translated into electrical impulses. These impulses are then sent over the line only to be re-translated faithfully into the same notes and noises at the other end of the line, using nothing but a single diafram on another telephone receiver. Before the telephone was invented, it was thought that for each note, a diafram or vibrating reed was necessary. Strange to relate however, a single diafram records the human voice single circular disc of iron 2½ inches in diameter and 1/64 of an inch thick. Nevertheless, the telephone to-day bears witness that it is eminently possible.

So the question logically arises that if all this can be done, why cannot light impulses be translated into electrical impulses at one end, and be re-translated at the other into light impulses?

Bearing these various things in mind, we have tried to picture the Telephot as we imagine it will appear when finally invented. Our front cover as well as the illustration herewith shows the writer's idea. The future Telephot will be an instrument attachable to our present telephone. The face of the distant speaker will probably be recorded on some sort of a fluorescent screen or plates, as we have here depicted. In order to show the picture to advantage, the frame F must be more or less deep, otherwise the sun or other light at the receiving end would interfere with the "received" picture. In other words, the picture would set back an inch or more as shown in our illustration.

The holes *H* belong to a highly sensitive transmitter (microphone), as it will be impractical for reasons which will be apparent to use the present day mouthpiece. All that the person at the other end need do is simply to talk in a medium low-pitched voice. The sound vibrations will be picked up by the sensitive transmitter, and will be heard sufficiently clear in the telephone receiver at the other station. In turn, the speaker's picture will be transmitted to his friend by means of the lens *L,* mounted in front of the Telephot. This lens is nothing but a photographic camera arrangement, and in the back of this "camera" *P,* the face or picture will be thrown just as a picture is formed on our eye's retina. Here the optical impulses are translated into electrical impulses which are now sent over the line along with the voice impulses.

In order that the distant person may *see* the speaker's face, it is of course necessary that the latter's face be illuminated. For it goes without saying that if the speaker was in the dark, his friend could not possibly see him on the other side because no light impulses would be thrown on the "sending" lens. For this reason it

Quite a good many Telephots have been imagined and described as well as patented in the past. None of these, however, have ever appeared—most of them only existing on paper. One of the first of these was invented by the Frenchman, d'Ardres, in 1877. There was another one invented by Sawyer in 1880. Next we have the Bidwell machine of 1881; the one of Weiller in 1889; as well as those of Szczepanich and that of Dussaud of 1898. None of these, however, were of practical value. We may also mention the comparatively modern Telephots of Rothschild of 1907; Belin apparatus of 1907; Kruh of 1910; Hoglund of 1912; A. C. and L. S. Anderson of 1912; Stille of 1915; the Rosing apparatus of 1915, and the Sinding-Larsen instrument of 1916. The more important ones among this host of Telephots will be described in this article.

One of the earliest Telephots imagined by the Frenchman, Dussaud in 1898, is illustrated herewith.

This ingenious apparatus at the sending end has a camera *A,* at the rear of which is a metal disc *B* perforated with certain holes. The disc is driven by clockwork contained in the case *E.* The ingenious part of this arrangement is that the disc *B* is perforated in a curious manner, the holes being disposed in the form of a helix or involute spiral. In other words, when the disc rotates the perforations cut off successive points of the picture formed in the camera *A.* Thus at each fraction of a second, a ray of light is allowed to fall on the selenium cell *C,* and when the disc has made one full rotation, every point of the picture will have been uncovered, as will be clear by a little reflection. It is apparent that the selenium cell *C* will receive various impulses due to the fact that more or less light reaches the cell. These impulses in turn are past thru a battery and a small transformer (induction coil) *D,* which is grounded at one end; the other wire goes to the receiving station. At the latter point, we receive more or less intense electrical impulses, and these impulses operate a very sensitive telephone receiver *T,* on which is hung an opaque plate *E,* having very fine transparent lines engraved on its face.

(*Continued on page* 51)

* Light entering the eye, influences the light-sensitive "rods and cones" of the retina, in some manner as yet not understood. The changes are supposed to be *photochemical* in their nature.

† The picture is actually transmitted at a distance. If the optical nerve is cut—the "wire" connecting the picture with the brain—we cannot "see" the picture, i. e., we will be blind.

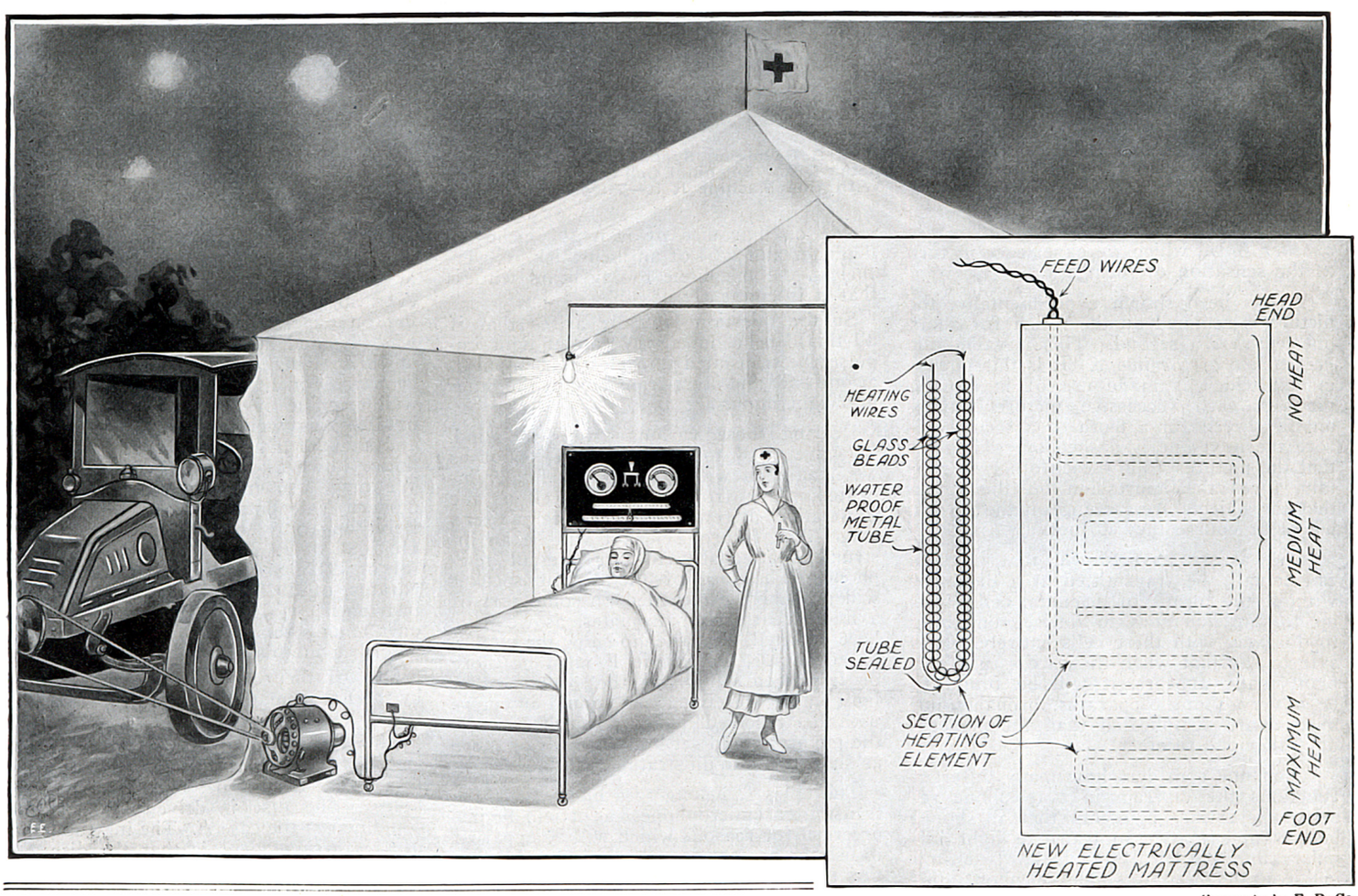
Electrically Heated Beds for the Wounded

ONCE it was thought that a patient was receiving the finest kind of treatment if he was surrounded by hot-water bottles, *i. e.,* providing he required that kind of treatment. Now the English hospital experts have devised an electrically heated mattress for treating such cases as pneumonia and shell shock. The hot water bottle provides an uneven heat at best—and for the proper treatment of such cases as these, the heating effect must be uniform and should be capable of fine regulation.

A successful solution has now been reached by Mr. H. J. Gauvain at the Treloar Cripples' Hospital, Alton, England, where two wards are now supplied with electric mattresses which have proved both safe and convenient in practise even when a child is the occupant of the bed.

The mattress does not differ in appearance from any other except that a flexible wire enters it at the head end thru a terminal which is flush with the surface, and therefore not exposed to injury. The resistance wire is insulated by glass beads in flexible metallic tubing incorporated in the substance of the mattress. The mattress is differentially heated and the heating element is so disposed that the maximum warmth is generated at the foot-end, less in the middle, and none at all at the head end. This distribution of heat is maintained in whatever position the mattress is turned, either from head to foot or side to side. The wires are connected with a switchboard on the wall at the head of a bed which contains a variable resistance, so that the current can be graduated to any required extent. It is so arranged that when the current is full on the temperature of the bed is raised 25° to 30° F. above that which would obtain apart from the heating, and this has been found in practise to meet the needs of the small cripples, many of whom are fastened on splints which do not allow of the close contact of the bedclothes. A fuse prevents the passage of any current exceeding this amount.

Several of the usual difficulties have thus been met: the temperature of the mattress can not rise to any dangerous degree, the tubing is so flexible that the mattress can be shaken or rolled up, and the resistance wire is water-proof in the spiral metallic tubing, so that no short-circuiting results, even if the mattress is wetted. The mattress may be sterilized in the ordinary way. The system is equally applicable whether the bed be in or out of doors. The saving of time at the Cripples' Hospital amounts to an aggregate of three hours a day in each ward where the electric mattress has replaced the filling or hot-water bottles, while inasmuch as the current required for maximum heating is only half an ampere at 110 volts, the total expenditure of energy for 200 or more beds would be by no means prohibitive. It is believed that the general adoption of a similar appliance in hospitals and infirmaries would save much time and relieve the nursing staff of a tiresome routine. Electrically heated beds have already been found of advantage in the treatment of shell shock at field-hospitals, and for military purposes it will be seen that the current required may be instantly supplied from a portable dynamo driven by a motor-lorry or car, as shown in the accompanying illustration.



Copyright by E. P. Co.

A Recent English Invention for Treating Various Ailments, Such as Shell Shock, Pneumonia, Etc., Consists of an Electrically Heated Mattress Which Can Be Regulated as Desired. Where No Electric Current Is Available It Can Be Produced by Hooking Up a Dynamo to a Motor Lorry. The Mattress Is Water-Proof and Can Thus Be Sterilized in the Usual Way.

GERMANS BUILDING ALUMINUM TRANSFORMERS.

Scarcity of copper has led to the construction of transformers with aluminum windings, says a German writer, and he contends that it is possible even in normal times to build air-cooled transformers cheaper and lighter if aluminum be employed instead of copper. The ratio of the prices of insulated aluminum and copper wire is taken as 1.4:1.0. In the most economical design of transformer with copper windings it is necessary to leave considerable spaces betwen the coils in order to obtain adequate cooling. When aluminum windings are used this space can be conveniently reduced without prejudice to the temperature rise. Owing to the relatively greater proportion of the cross-section of the coils which is occupied by metal, the difference between internal and external temperatures is less with aluminum windings than with copper. The difficulty of making joints in the winding is rather serious.

A New Phonographic "Loud Talker" for Public Places

By H. WINFIELD SECOR

POSSIBLY many readers have seen, or rather heard, loud-talking telephones in operation as the latter's sphere of usefulness is being extended daily. They are being used very successfully for announcing trains in railroad terminals and have been used for several years now in announcing plays from the fronts of theaters in the larger cities, such as New York, and they have also found considerable adoption in railroad train despatching, as well as in a number of other nelds.

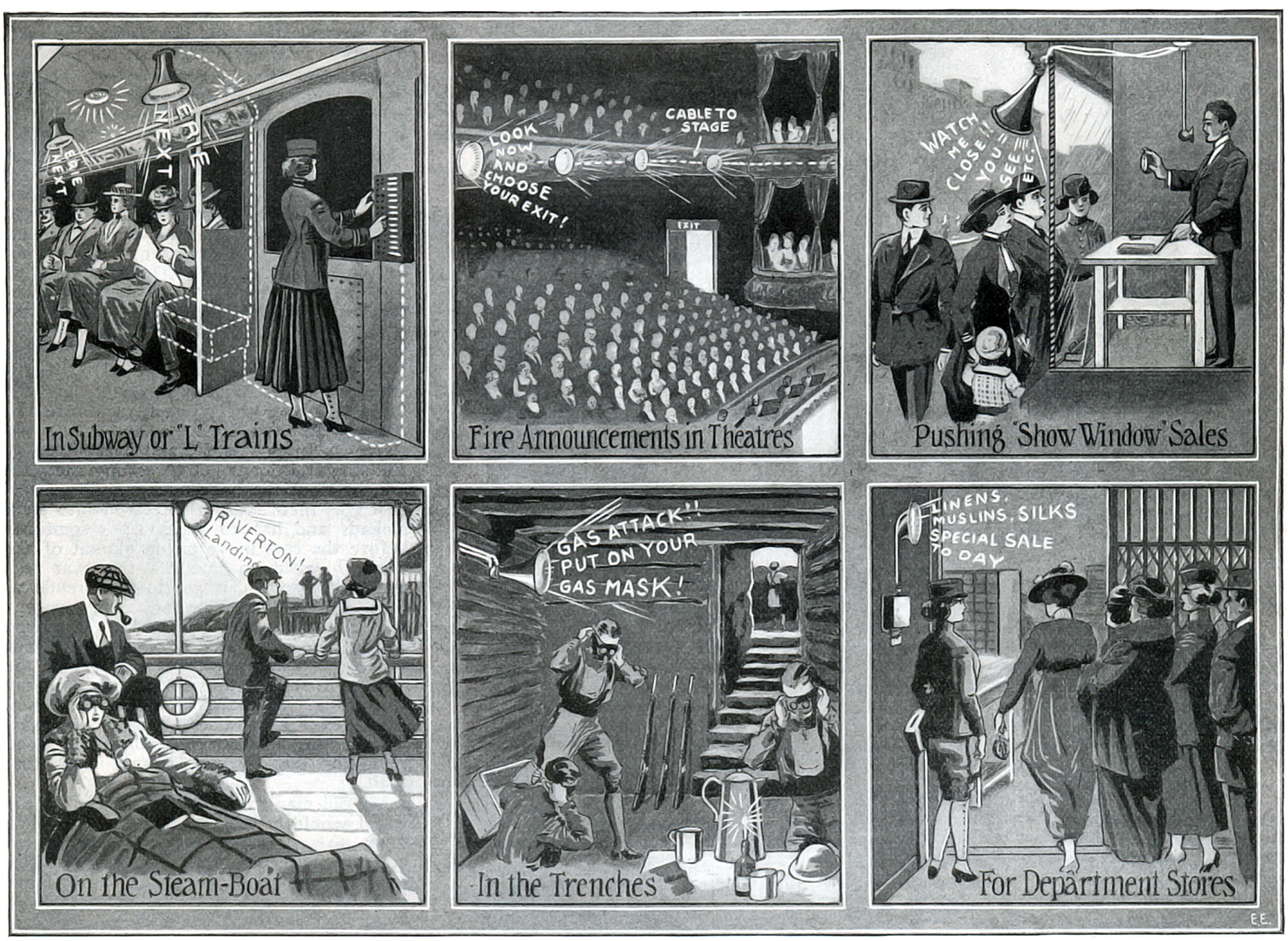
The writer, while recently riding on a subway train, thought of the idea of combining these successful and practical loud-talking telephones with a phonograph attachment, which arrangement would seem to fill a great many requirements in public places, such as in subway and elevated trains, on steamships, in department stores, for store window sales, in theaters, et cetera.

A diagramatic layout, embodying the principal features of the phonographic loud-talker as here proposed and as it might be applied specifically for the purposes enumerated below, is shown herewith. Briefly considered, the phonograph attachment would consist of the proper number of cylinder type phonograph records mounted somewhat after the manner shown in the drawing, so that each respective record could be put into operation in response to each push button as becomes evident.

It will probably make the matter clearer to follow thru one stage of operation on such a loud-talker, provided with automatic speaking attachment in the form of a phonograph. Let us consider that this device was to be used on such trains as those operated thru the well-known Hudson River tunnels connecting New York City with New Jersey. The trains running between the Hudson Terminal or Cortlandt Street, New York, make but four stops, and these are shown in the diagram, being respectively Cortlandt Street, Pennsylvania Railroad (Exchange Place), Erie Railroad and Hoboken. Each phonograph record would be made up with the proper number of repetition sentences for each respective stop, as, for instance, the Cortlandt Street record might contain the record, "NEXT STOP CORTLANDT STREET — NEW YORK—ALL OUT," and this might be repeated several times with a brief interval between each sentence.

This idea was conceived for one particular reason, and that is that these trains are gradually being supplied with women guards, and it was noticed by continual every-day traveling on them, and especially when the trains were crowded, that many of the women guards spoke in such a low voice that their announcements of the next station could not be heard beyond a few feet. With this arrangement, which is not only practical, but extremely feasible, the lady guard would simply push the properly labeled button on her key-board, the key-boards to be placed on the frame of the car door at which the guards are stationed, when the following operations would automatically take place: A small pilot light alongside of the push button deprest would light, showing that the apparatus was functioning properly; a magnetic switch would close and remain closed, as the diagram shows, by virtue of a spring actuated trip; this switch would close two distinct circuits, one thru the proper magnetic clutch on the common motor drive shaft, thus putting into operation the "Cortlandt Street" record and its corresponding reproducer and attached microphone, while the second circuit, closed by the automatic magnetic switch, would pass thru the micro-

(*Continued on page* 51)



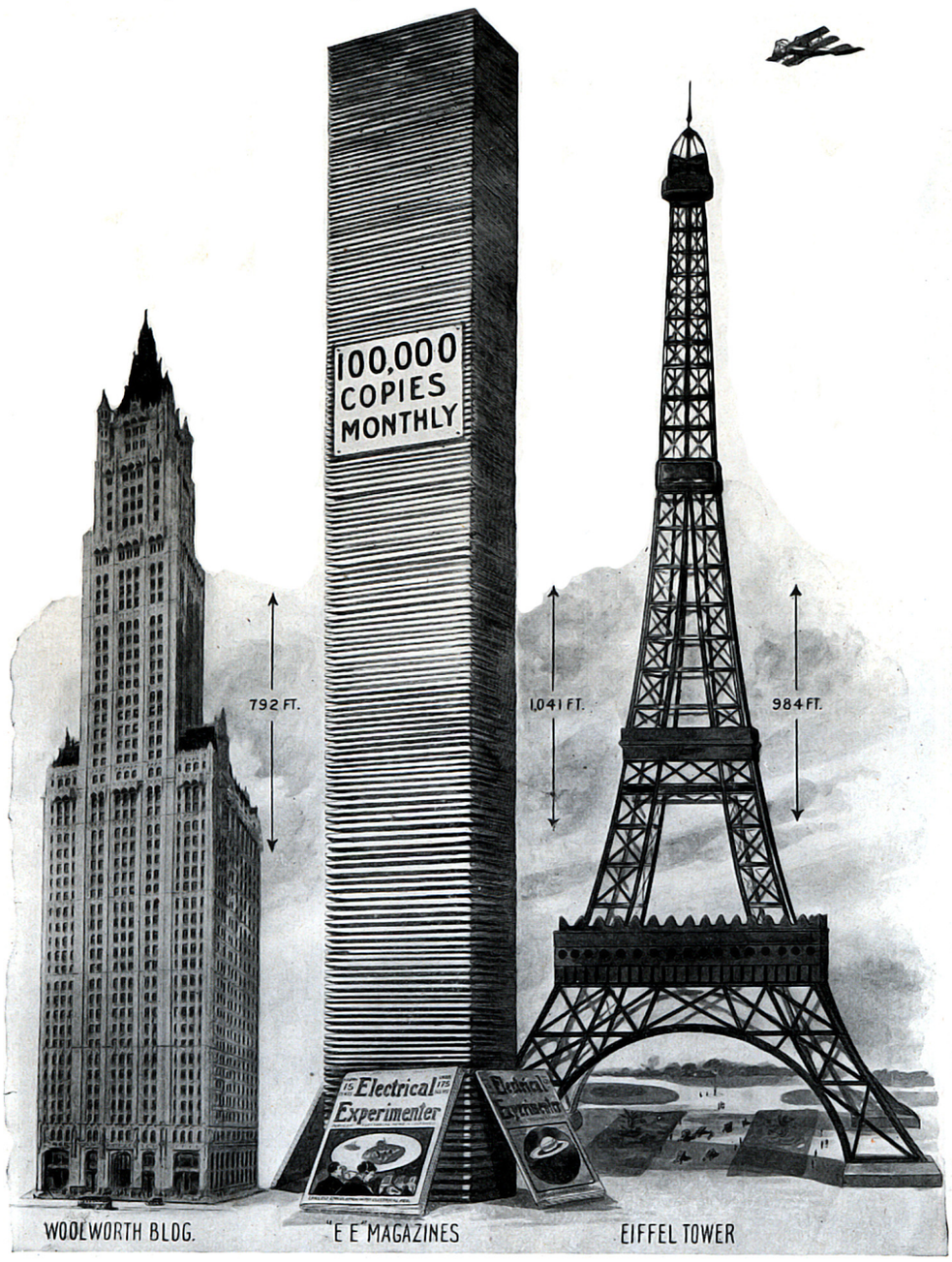
Copyright by E. P. Co.

Why not Make a Real Practical and Useful Application of the Phonograph by Combining it with the "Loud-Talking" Telephone as Illustrated in the Accompanying Views? It Would Save Much Confusion and Misunderstanding in All Public Places, Such as in Subways, Theaters and Stores.

"Vol. 6, No. 1"

By "ELECTRICAL EXPERIMENTER"—Herself

MY parens *all*wais say that nice peepel dont talc about themselvs and I gess their rite. But today Im 6 years old, so I kno you will excoos me for onct. i kno of coarse thet littel girls shoud be seen an not herd, but then i am such a lusti littel thing and *so* big for my age that i cant help being herd all over the United States an mutch *mutch* ferther then that. i am now herd every mons all over the sivilized woarld from New seeland to Norwai, from india to shili, from Transvahl to Tchina and from Kanada to Djapahn. they all kno my vois and wellkom me evry mons. Thats pretti good for a six year old isnt it now? ! ? Besids i cant help being loud at Times for my parens put me in *sech* a loud new dres evry mons thet i think thei sekretly doant mind it a bid if i am herd so much and thet so meny peepel talk about me every mons, an if it wasnt for my modesti I would tell you thet all the best girls and even old respektabel ladis all over the countri talk about me evry mons. For instans *the literari Diges, the New York Woarld, the New York Tribuhn, the New York sun, the bostn transkribt, the philadelfie inkwirer, the chicago Tribuhn, the New York American, the Sinsinatti Enkwirer, the Clevelant Plane deeler, the saint-luis Post despatch,* an lotsanlots of other nice littel girls all over the countri print nise storis about me *evry* singel mons. an do you know that i am the *Biggest* electricl young girl in the *entier* woarld now? Bigger then *eny* other 3 electricl girls *kombined!* i go now to *over* one-Hundred-sou-sand peepel every mons! 100,000 good an stantch frends! And no make belief frends either. no sirri, my frends pai for me to kom to ther Houses—evry one of them, honest. An moni toalks dosnt it now? Do you wondr thet i am prout an a bid stuk up?



With This Issue the ELECTRICAL EXPERIMENTER Is Six Years Old. For Some Months Past the Circulation of the Magazine Has Been Over 100,000 Copies Monthly, Which Is MORE Than the COMBINED Circulation of the Next THREE Largest Electrical Periodicals. Not Bad for a Six-Year-Old! How High Would 100,000 Copies of the EXPERIMENTER Stack Up if all Were Placed on Top of Each Other? The Above Picture Tells the Story. Each Copy Is 1/8 Inch Thick and 100,000 x 1/8" Equals 1,041 Feet! Laid End to End the Magazines Would Reach 19 Miles, a Distance from New York to Paterson, N. J.

Of coarse i wasnt **all**wais so big. Wen i was first borned I wend onli to 3000 peepls' Houses evry mons but then my parens got a new addishun to the fambly one day and his naim was *advertisn Manger.* An he lookt at me an took me in his hands and put up his nos and sneerd. An then he sais, sais he, feeling my puls, why the poor thing has no sirculashun, *how* can i ged ads for it? ! Thet maid me feel awfull sik but my parens padded me on the hed and sed, o thats eesy we will fiks thet soon.

So thei went an put nise brite dresses on me each mons, en then thei got the best peepel in the countri to fill me up with nise storis and artikls and rite-ups and then thei hiret the best artisds in town to paint an draw fine pikturs for me evry mons. An soon peepel was watchn for me all egsited evry mons to kom to their Houses. An wen i doant get their on time thei sent awfull kiks to my parens an sai I just *got* to kome or theil make it hot for em, thei like me *thet* mutch! An if thet isnt apreshiashun i honesly doant now what is, isnt it now?

An beleif me it keeps me bisi, evry mons I go to over 16,000 houses thru the mails an 87,000 peepel tak me hoame from noos stands all over the countri, in Kanada in england an even in far away war torned Parees. An my noos stand byers kik awfulli too if i doant get *there* on time. An *thei* ball out the poor noos stands men as if it was *their* foalt when I run into train blokads and haf to wait weeks somtimes before the cars move on on akount of the war. I wisht to goodnes this war was over with, so I can get to my frends in time. I jest hate to be late an my parens the poor deers do their best to chais me out on time, even *ahed* of time but it doant help eny. An its getten woarser all the time. An it aint the woarst part that my frends kik. My parens kik *much* woarser. Their *never* satisfid with me. Thei allwais kik an fuss about me. I am *never* good enuf for em an thei allwais find more foalt.

My old man sais thet if it werent for the war I would be mutch biger an fatter then i am now. He sits up nites, sundais an holidais an skemes how to make me better looken an how to kram moar stuff into me. Sometims i think i bursd im *so* full of good stuff, but *he* doant think so. no sirri. las mons he spent over 400 dallers on me for artisds woark aloan, jest for the piktshers en then he had 3 kat fids when he sawr the bils. But he swaload hard an said, well i gess itl pai in the end. jest you wate till the war is over an i'll show em how to dress you up. youll be so fat and plum thet itl take your frends a week to lissen to all youll hav to tell em.

Well i gess the old man nows best but i wisht he wouldnt find so mutch foalt with me. we cant all be perfekd, can we! ? !

An lissen heres a good joak on him jest to show you thet he isnt perfekd ether. i hoap when se sees this he wont find so mutch foalt with me eny more.

Well in my februry dress on page 675 he went an printed a piktsher of a *buldoag sigar liter,* an then he went an rote a lot of doape an ses reel airi like, *sip, gos the butten and pressdo your sigar is lited.* jest

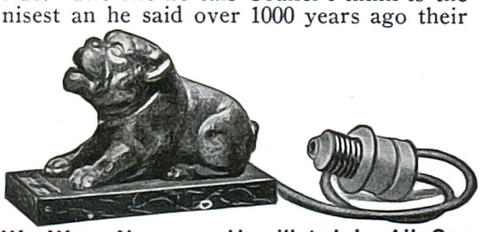
like thet. An what do you think, the poor old fish never saw thet liter at all. The manufakterers jest sent him the piktsher an he wroate his own doape, thinking how smart *he* was an jest gessing all about it.

An pretti soon 100 and hundreds smoaking peepel began to rite him about thet dandy bulldoag sigar liter and wanted to now *who* made it so thei could bui one for their dens and their smoaking rooms an for their klub. jest look at the piktsher, *isnt* it a kiute littel sigar liter, o yes.

So dad went an sent all thoas 100 an hundreds of leters to thet Chicagoa Bulldoag sigar liter manufakterer bekaus he thot that maibe thei would give him a big ad for me. Yes like shuger thei did.

An what do you think *thei* went an rote dad? Thei thenkt him for all thoase nise leters but wanted to now if dad was batti in his skilite and what he ment by colling their poor dear good old bulldoag a sigar liter when poor fido was a *ladis kurling iren heater,* an not a sigar liter at all?!? My wasnt dad soar when he found out the bull hed maid of thet bulldoag?! the aire arount him was bloo for ours an ours an he triet to blame it on everi one in the plais. Poor old dad how could *he* hav gessed thet fido is hallo insides of him an thet their is a heating ellement inside the insides to heat mas or sis kurling iren in??! But you cant beat dad. for you now what he went and did. youd never gess. well hes got the nerv to rite thoase Bulldoag peepel that with a littel change thei could konverd the kurling iren heater into a sigar liter *eni way* an sell em to all thoase peepel an thet *thei should be thenkful to him* for having gave them sech a good idee all for nothing?!! Can you bead it!??!

But i reeli shouldnt mak fun of dad for he gave me a lot of brant new hats for my 6t birthdai. He calls em headings an he spent a buntch of moni on em and I like em. Doant you think their reel peechi!?! i do. The one he cals Orakel i think is the nisest an he said over 1000 years ago their



We Were Never so Humiliated in All Our Lives. Here We Went and Told You in Our February Issue that this most Honorable Dog was an Electric Cigar Lighter—but Alas and Alack it Ain't! But what is It? We are Ashamed to Tell You in Black Face Type. It's Too Glaring, so Please Read the Accompanying Story.

livd a ladi in a desert in a O-asis an her naim was miss Orakel an *she* told all the peeple what *thei* didn't now about an she was awfulli wise. An therefor now when my friends wan to now something or other i will tell them all about it thru my orakel thats pretty good for a six year old isnt it now!??!

Now thet Ive tole you all the latesd gossib i want to ask you a favor, a favor for me and one thet will help you lotsanlots 2.

Dad sais thet my frends doant read my ads enaf, and thet thei dont rite often enaf to my advertisrs. An he sais thet if thei only would and *keep it up* he could add 32 texd pages to me within 6 mons. Gosh i'd never beleif it but the *advertisn mangr* sais its so, so it *must* be so after all.

You see dad spents all his moni on my texd dresses and blows in moare on them then he gets bak outo my ad pages, so at the end of the mons he ows hisself moni. An yesterdai the printr blos in with a new kontrakt an wants 20 persent moare to get me out evry mons. good nite, i thot dad would ether drop thru the floar into the seller or sale thru the seiling but he jest

(*Continued on page* 50)

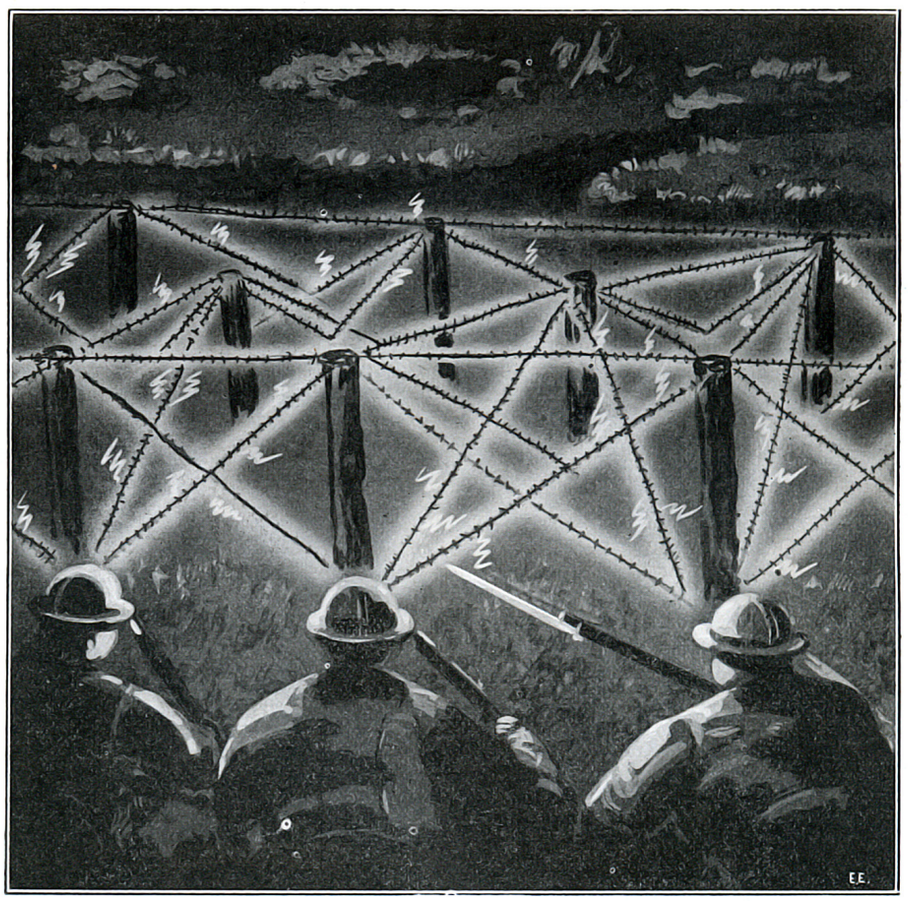
U. S. Patrol Escapes Hun's Electrified Wires

An American patrol, having past the first line of German entanglements and approached the second line on a recent raid, was suddenly cut off by a current of electricity sent along the wire line.

Instead of attempting an immediate return to their trenches, which would have meant certain death from electrocution or machine gun fire, the Americans clung close to the earth, and, later, when the electricity was cut off, returned in safety to their positions.

It was a thrilling experience for the patrol. The men set out from the American position in the hope of encountering the enemy at a point in the German trenches. They had succeeded in getting thru the first line and had crawled on until the second line was reached. When they were just about to start under the second line there was a bluish glow and, turning around, they saw long, livid sparks playing thru the barbed wire of the first line. The enemy had turned on a powerful electric current.

The patrollers quickly flattened out on the ground, thinking they had been discovered and expecting to hear momentarily machine gun bullets singing overhead. Nothing of the kind happened, however. Apparently the Germans merely turned on the current by chance, hoping that if any Americans were within the entanglements they would be killed on the wire or while trying to get out. The patrol returned safely to the American lines when the electricity was turned off. Usually a high tension alternating current is used to charge barbed wire entanglements; a potential of several thousand volts is necessary.



An American Night Patrol in France Recently Had a Narrow Escape From Electrocution, When the Teutons Turned on Several Thousand Volts of Electricity thru Their Barbed Wire Entanglements in "No Man's Land."

An electric forge which requires but one man in its operation has been invented in England for use in munitions factories. Heretofore a forge has always required one man to hammer the iron and another to hold it on the anvil. Under the new system electricity does the hammering and the operator merely holds the iron and regulates the electric hammer.

A NEW DISCOVERY.

According to the New York Sunday World "Comic Section," Whenever You Want to Blow Up a House, Throw a Monkey Wrench Into a Dynamo! Simple, Isn't It? Hawkshaw, However, Fails to Enlighten Us Just How the Dynamo Blows Up the House. Too Bad.

"Sub"-Detector, Thriller In New War Play

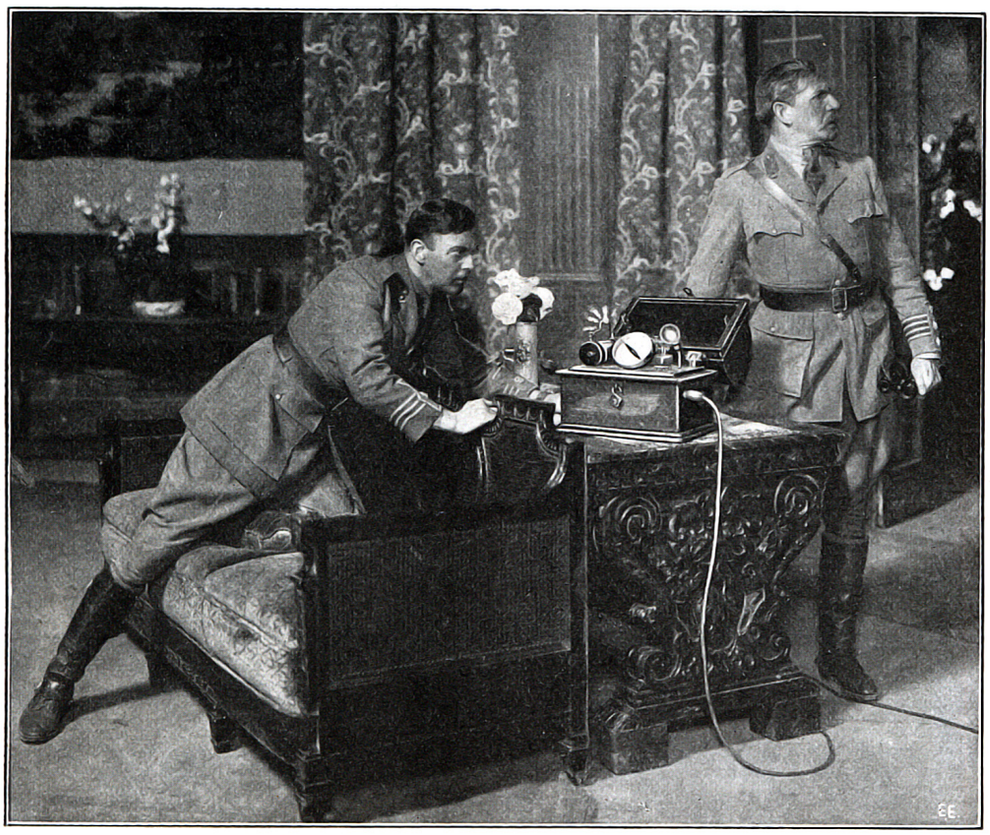
DID you ever hiss the villain!! "Ask dad" he knows! In the palmy days of the drama "pop" used to line up in the gallery and watch the villian steal the heroine, only to be foiled by the noble hero who always dropt in at the right moment! Then too, we had the wily adventuress who always tried to lure our hero away from his woozy-woozy. Do you remember those days! I'll guarantee not many of you do.

In these more advanced times it's the "movie" villain who holds our attention, and he usually wears a wrist watch!! Even then he can't hear you when you try and give him the razz!! Such being the sad and distressing circumstances, energetic producers have awakened to the crying need and presented the American public with a regular old-time drama, imported from England where it has played for more than a year.

Set to American ideas with none of the thrills left out, with a real American hero and heroine, villains, spies, adventuresses, henchmen and all the rest of the "fireworks" handed to you under the title of *Seven Days Leave* and you have a real, live, heart-throbbing, patriotic war play, that is bound to wake up that slumbering spark and send you looking for the nearest recruiting station.

The story surrounds itself with the expected arrival of Major Fielding at Colonel Sharrow's house, Hampton Sandy, England. He has with him a special device which he has been working on, that will detect the presence of submarines. Incidently he is in love with Lady Mary Heather, a neighbor of the Sharrows.

He arrives with a model of his wonderful machine and also the working plans of the same. While there, the plans are stolen by German spies who are in the guise of Belgian refugees. Then begins a series of dramatic incidents, thrills, heart-throbs and all thrown in, which lead to the capture and end of the plotters with U. S. Destroyers in action and the final sinking of the submarine—with the lovers united again.



Electricity, Microphones, Spark Coils, True Military Atmosphere—All Abound in "Seven Days Leave," the Latest New York Dramatic Success. The Electric "Submarine Detector" Is Here Shown in Full Activity—Every Time a Submarine Is Located Its Exact Position Is Indicated by the Calibrated Magnetic Needle.

It is interesting to note what novel applications and innovations have been adapted to stage and screen during the past few years.

The accompanying photo is a scene from the play wherein Major Fielding and Colonel Sharrow are testing the practicability of the submarine detector. An electric cable has been laid to the water-front and a sensitive microphone placed in the water. The machine is supposed to show the presence of a submarine and also its position from the microphone. The machine on its test indicates that a submarine is present which causes them great surprise. Later this proves true and the submarine is blown up.

The cast is noteworthy, and should be commended on the spirit shown thruout the play. So if by any chance "Seven Days Leave" should play your town or near your town—even if you have to walk twenty miles—by all means don't fail to see it!! —George Holmes.

RUSSIAN INVENTS ELECTRIC MACHINE TO BEHEAD 500 AT ONCE.

Shades of King Henry the VIII, what are we coming to. Modern science has come to the aid of the Bolsheviki, in case they decide to imitate the French revolution and introduce the guillotine, in the person of a Russian engineer named Blubin. He has submitted a new type of that instrument to the council of people's commissaries, and which is said to work by electricity; it will behead 500 victims with one stroke! Next!!

AVIATORS USE ELECTRICALLY HEATED CLOTHES.

The accompanying photo shows two members of the British Royal Flying Corps donning their electrically heated gloves and foot insoles, preparatory to starting on a cold night trip over the German lines. The current for heating the gloves being obtained from the storage battery or dynamo of the 'plane. In the aviation service of some of the allied forces electric heating for all the clothing has already been quite extensively adopted. The aviator will thus be enabled to attain higher altitudes without inconvenience from the extreme cold of the upper air currents.

Photo © by Underwood and Underwood

Two Members of the British Royal Flying Corps Are Here Seen In the Act of Donning Electrically Heated Gloves and Foot Insoles, Preparatory to Making a Night Trip Over the German Lines.

Research and Its Importance to Human Progress

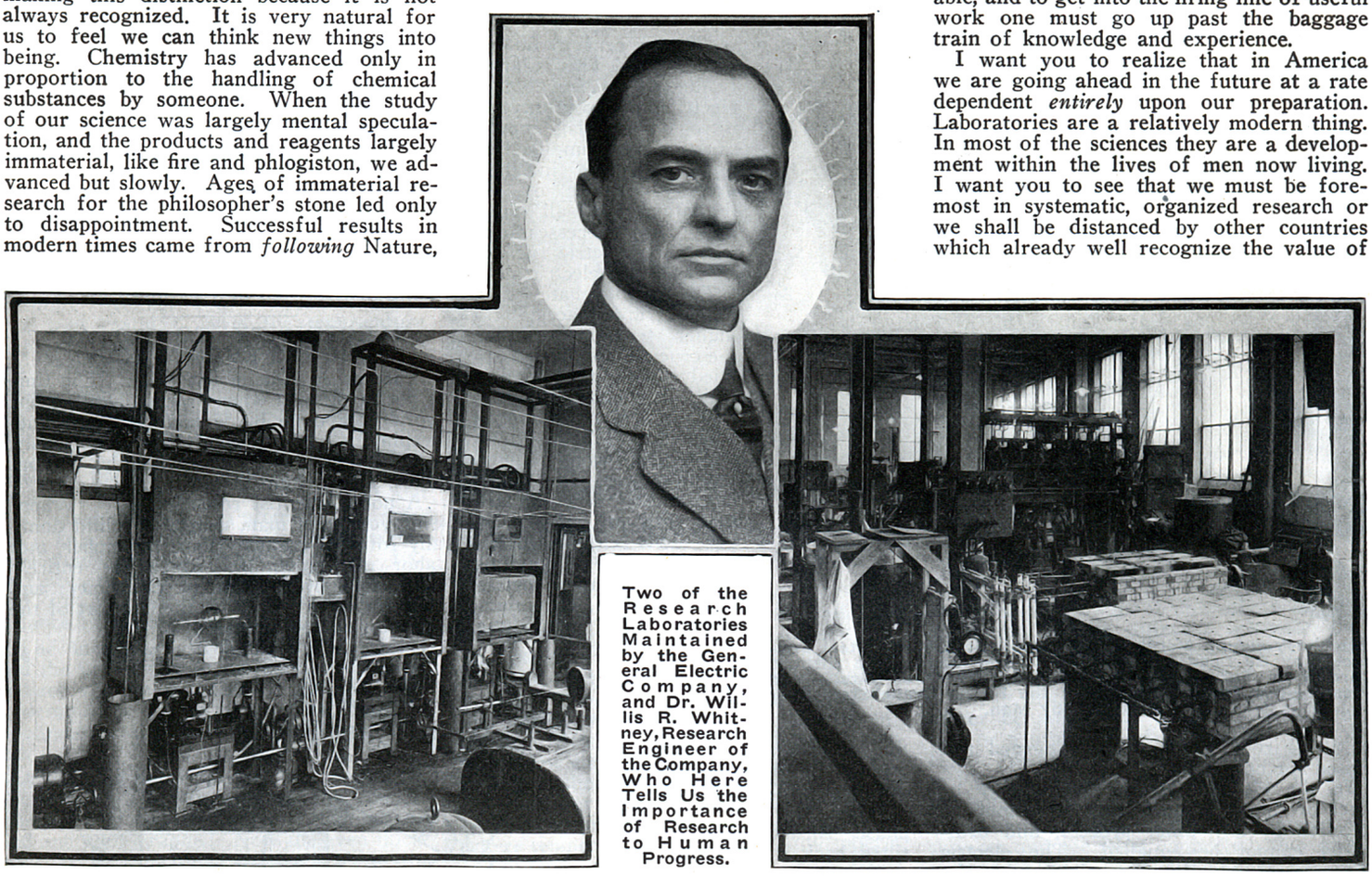
By Dr. Willis R. Whitney
Research Engineer, General Electric Company

THE object of this paper is to emphasize the importance of material research and to lay stress on its necessity to any people who are ever to become a leading nation or a world power. I have called it material research because I wanted to exclude immaterial research. I class under this head pure thought as distinct from thought mixed with matter. It is worth while making this distinction because it is not always recognized. It is very natural for us to feel we can think new things into being. Chemistry has advanced only in proportion to the handling of chemical substances by someone. When the study of our science was largely mental speculation, and the products and reagents largely immaterial, like fire and phlogiston, we advanced but slowly. Ages of immaterial research for the philosopher's stone led only to disappointment. Successful results in modern times came from *following* Nature, learning by asking and experimenting, reasoning just enough from one stage of acquired knowledge to ask the next question of materials.

Man seems to be the supreme, mentally elastic organism. He develops by trying novelties and by taking new paths. No one knows to what extent he may develop, but everyone knows that thru acquisition of knowledge, or, let me say, production of it, he may transcend any physical limits. This will not come about by continuous repetition of what we have already learned. Monkeys and parrots do as much. It will come thru the continual and active appreciation of new knowledge.

In the advance of civilization it is new knowledge which paves the way, and the pavement is eternal. While the physical structures of man are decaying, the facts he has learned are ever doing new service. Antitoxic devices will be increasing when locomotives are forgotten. Magnetic induction will work after the pyramids have blown away. We ought to see that everything distinguishing our lives from those of Indians has come from studying something new.

Scientific research, or research in the natural sciences and in the industries, might be defined as the pioneer work of the *developed* country. In this light it is easy to see that our turn has come. Not long ago our pioneer work was of another kind. It was opening up the undeveloped land. It was actively and well done. But the work must change, because our requirements have altered.



Two of the Research Laboratories Maintained by the General Electric Company, and Dr. Willis R. Whitney, Research Engineer of the Company, Who Here Tells Us the Importance of Research to Human Progress.

I do not want you to look at research as an old, established utility. I want you to see it as I do: a powerful factor proved by the advance of the industrial welfare of the foremost countries, and a world-experiment of less than a century's trial, but something still unappreciated in America. It is true that the earliest man and many of the lower animals accomplished ends by research, but I refer now to research in the natural sciences and to the research which in our day is necessary to our desired activities. These sciences are already very highly developed, and advanced education is demanded by them. For example, if I wish to cure physical ills, I cannot expect to do it by reciting ancient incantations, nor by using roots and herbs, as was once customary. I must first familiarize myself with an accumulation of previous experience. I must study anatomy, physiology, chemistry, bacteriology, etc. This is a relatively recent world-condition. Copper, iron and five other metals were known and used at the time of Christ. In the first 1,800 or 1,900 years of our era there were added to the list of metals in technical use (pure or alloyed) about eight more, or a rate below three a century. There has been so much industrial advance made within the past twenty to thirty years that *fourteen new metals* have been brought into commercial use within this period. This is almost as many in our quarter century as in the total preceding age of the world. Conditions are similar in all the applied sciences. The accumulated knowledge in any field is already very considerable, and to get into the firing line of useful work one must go up past the baggage train of knowledge and experience.

I want you to realize that in America we are going ahead in the future at a rate dependent *entirely* upon our preparation. Laboratories are a relatively modern thing. In most of the sciences they are a development within the lives of men now living. I want you to see that we must be foremost in systematic, organized research or we shall be distanced by other countries which already well recognize the value of *new* knowledge.

When so much of our material welfare, the condition and extent of our manufactures, the quality of our agricultural efforts, and the health of our people, depend upon the rate of our acquirement of *new* knowledge, there ought to be much greater effort made along the lines of research than is at present the case. We call knowledge power, but we need to see that *new knowledge* is the second power of power.

I am in favor of anything which helps train the American student in the path of sanguine research. It can be done by research men themselves, but probably not by others. It is not the *knowledge* which the student preparing for research needs, so much as the spirit of the investigator. His thoughts should not be fettered by laws, but helped by them to fly. This can be done best by those who are optimistic almost to the extinction of reason.

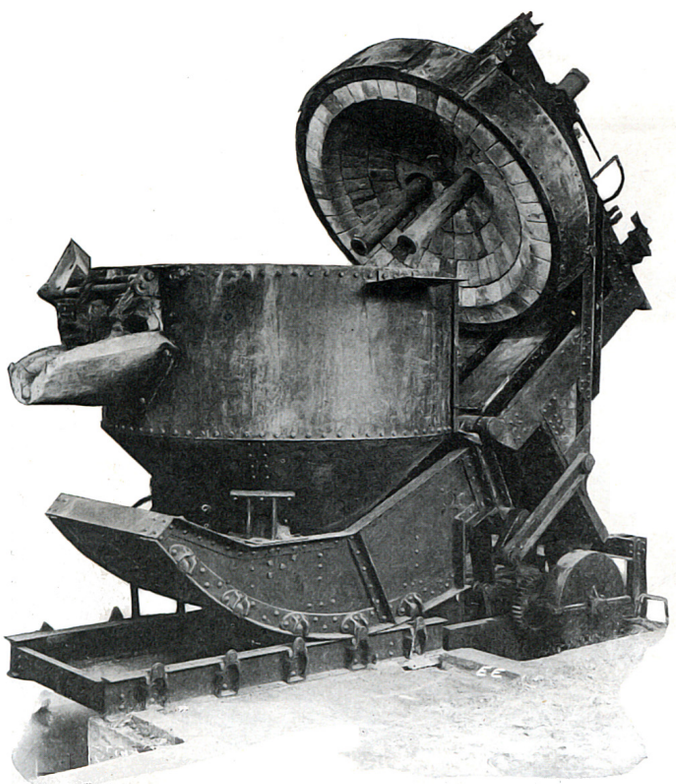
All service is based on knowledge, and knowledge is an ever augmenting thing which almost anyone may increase. If the stock is *eternally* useful, as it is, how great must be the value of the *indestructi-*

(*Continued on page* 48.)

Modern American Electric Furnaces

By Frank C. Perkins

THE accompanying illustration shows the design and construction of a powerful industrial electric furnace developed at Chicago. The photograph shows a 5 ton, 3 phase electric furnace with two electrodes mounted in a tilting roof which may be opened and closed for operation.



Into the Yawning Mouth of This Gigantic Electric Steel Furnace May Be Loaded Five Tons of Steel Scrap—the Electric Current Is Turned On, Powerful Electric Arcs Sizzle, and Presto!—Out Pours a Stream of the Finest Grade Steel Ever Produced by Man.

In the electric furnace the quality of steel produced is such that it cannot be excelled by any other process, and ordinarily cannot be equalled. The electric furnace is virtually a crucible, with the heat of electric arcs on the inside—thus making it possible to melt and refine steel without the objectionable features of the blast. It leaves the metal freer from oxygen, nitrogen and other gases or slag inclusions.

As to the cost of the produce it is competitive with, or lower than, open hearth, converter, or crucible processes. This is in generál due to the fact that steel foundries using electric furnaces make up their entire charge from old scrap, which in any market is enough lower than the combined scrap and pig used for the charge in other processes to offset the quarter of a cent per pound which electricity averages for conversion.

As the material is put directly into the furnace and its constituents are not oxidized unless oxidizing materials are put in for that purpose, the process is simple and the steel maker has the simple problem of having fewer elements to deal with and it is equally advantageous for steel or iron, and will prove as profitable for the small foundry as for the big steel plant. The rapidity of the process as compared with the open hearth practises, saves molding floor space and effects numerous economies in the form of labor and other expense.

It is maintained that electric steel has greater density and is free from the blowholes that entail so much machining loss when discovered too late, while its tensile strength is 10,000 lbs. per square inch greater than open hearth steel.

Electric steel has an elastic limit from 5 per cent to 15 per cent greater, and its working yield-point is 20 per cent to 50 per cent greater. This is largely due to the freedom of electric steel from oxygen, nitrogen, and slag impurities which flame-heating processes leave in their produce because of the limitations of all fuel-melting processes, and which the electric furnace refines out of electric steel.

The fusing material in the electric furnace is at a higher temperature than the crucible, the heat is applied inside the crucible while in fuel-melting furnaces the heat is applied outside the crucible. Chemical composition of consecutive heats can be held more closely to a standard than with any other process. This is the most noticeable when handling easily oxidizable metals, like vanadium, chromium, silicon and manganese. Alloy additions may be made in the furnace itself rather than in the ladle, which increases the factors of thoro assimilation, diffusion and homogeneity.

When the five ton, three phase furnace has its roof tilted back it is in the charge position. This furnace is equipt with two top electrodes and one bottom connection to the bath. After the charge has been dropt into the furnace, the roof if pulled forward by a motor and sealed with a dry fire clay gasket. The spout is closed and the furnace is practically sealed, resulting in the most rapid deoxidation of the steel. The electrodes are motor operated and an automatic regulator controls the motor operated electrodes.

HOW NATIONALITY WAS CHANGED.

A fellow crazy with the heat propounded this: Two Americans fell out of an airship; what nationality were they when they came down? We let the poor nut rave, and presently he gave us the answer. One came down a Russian, he said; the other landed on the telegraph wires and came down a Pole.

TO THE U. S. SIGNAL CORPS.

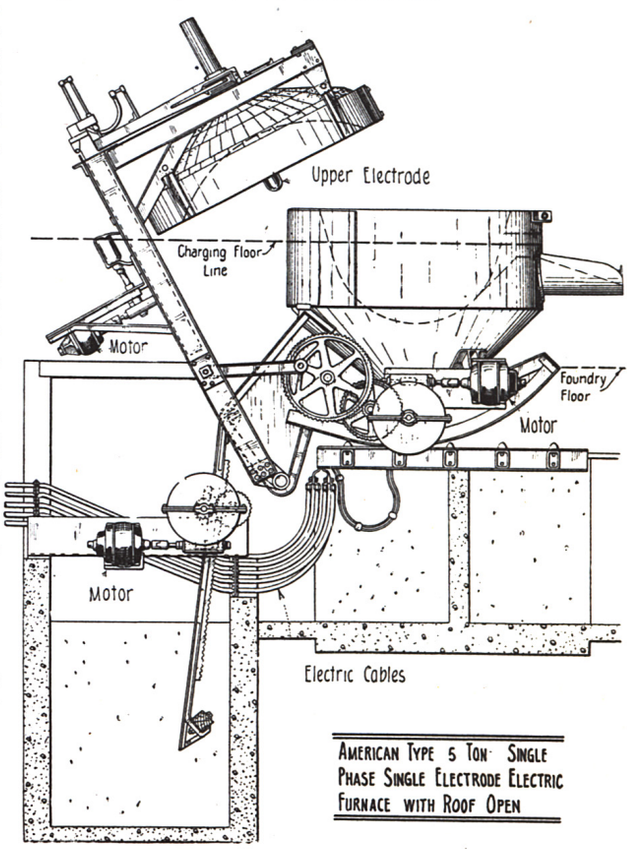
You could get along wthout the infan-tree,
If such a thing should really have to be;
You could let up on "typewritin',"
Quit most other styles o' fightin',
And keep a battle goin' 'cross the sea;
But I'll make an affidavy at my dear old mother's knee
There wouldn't be no battles in the trenches 'crost the sea;
Oh, there wouldn't be no chanst for them to carry on the war,
Without the kind assistance o' the U. S. Signal Corps.

Charley Gordon, with a ukelele, sang this at Camp Upton recently. . . . The point may be adduced in *vers libre;* the signal corps is, after all, the nerve system of modern warfare. Take from the artilleryman the news of what his shells and shrapnel are accomplishing out beyond in the unseen and his big guns are as good as silenced. Take from the infantryman means of quickly receiving and passing along orders—and he's a cooked goose.

ELECTRICITY TO DO ALL CHORES EVENTUALLY.

Thomas A. Edison has said: "The time is not far distant when practically all of the work now done by woman in her housekeeping, so painstakingly and laboriously, will be done better, more simply, without labor, by machine."

A noted scientist recently said: "Whenever you see a man, woman or child doing any form of manual labor, remember, *that* labor can either be reduced or entirely eliminated by the use of electricity; and that in nearly every case the comfort of the operator can be increased."



Sectional View of Five Ton Electric Arc Furnace With Motor-Operated Roof Tilted Back Ready for Charging. Even the Electrodes are Motor-Fed.

Electric "Sherardizing" Prevents Rust

TO assure protection against rust a *sherardizing* process is now standard practise for many electrical and mechanical products where rust prevention is a vital necessity.

Marked improvements in methods of sherardizing have taken place since this practise was first adopted and have resulted in a uniform product with highly efficient protection to the devices so treated.

The process of sherardizing consists of baking the parts to be treated, with zinc dust of the correct chemical analysis, at a predetermined constant temperature, for a period of time depending upon the thickness of the protective coating desired. The zinc is deposited both into and onto the surface to be protected and by entering the pores of the metal becomes a part of the device itself. There is, therefore, no tendency to crack or scale off even when subjected to distortion or changes of temperature.

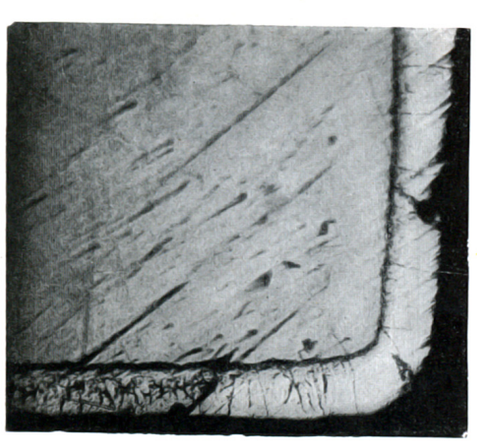
A feature of sherardizing is that when applied to threaded surfaces these are protected as thoroly as the other parts and yet can be turned into place with absolute freedom. Neither does it weaken malleable iron castings, since the temperature employed during the treating process is comparatively low.

As a result of the adoption of these methods one of the largest electric companies has developed its own electric ovens for the process and its own testing plant, where pieces of the finished product are subjected to a test of 168 hours in a spray of salt water projected thru an atomizer by an air jet. This is a condition far more severe than would be encountered in service. Experience proves that the ability to stand this test for a week forecasts indefinite resistance to atmospheric conditons.

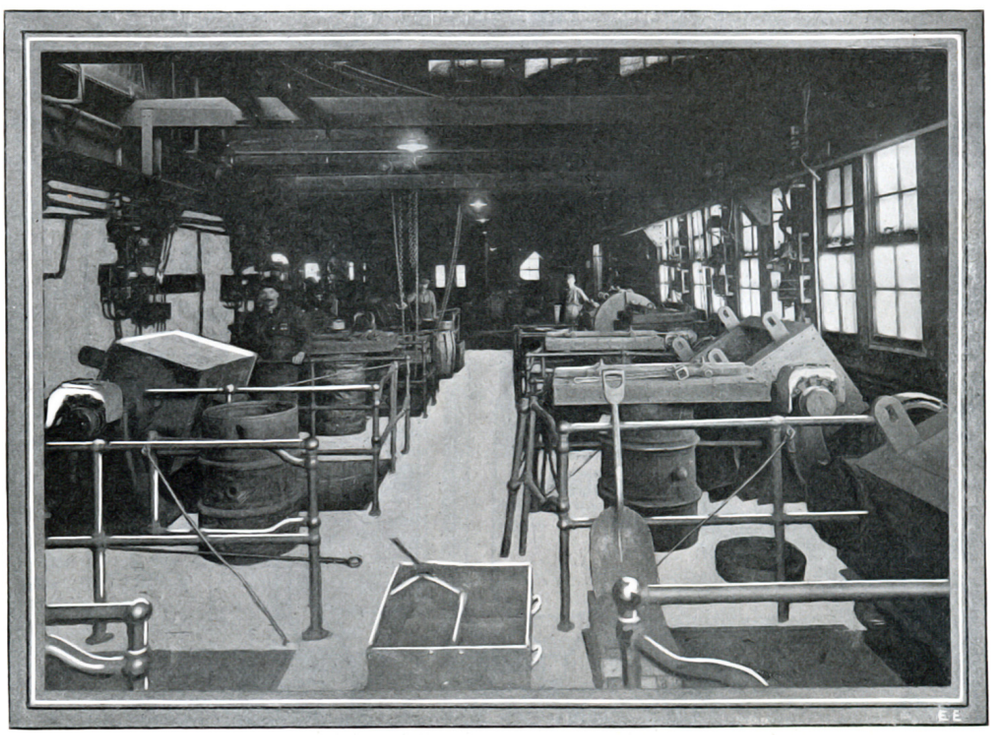
The inordinate strength, the durability and the uniformity of the Electrically sherardized coating on steels is not generally understood. To explain these facts a microphotograph is shown in the smaller cut.

A piece of polished steel was electrically sherardized, cleaved to show the connection between coating and steel then magnified and photographed. Note the even thickness of this coating, particularly at the corner. Electric sherardizing made this possible.

The black line between the coating and the steel is the juncture of the two substances. Small as it is shown, this juncture has been *magnified* 150 *times.* The final weatherproof coating, if desired, can be given a polish equal to nickel plating.



Microphotograph of Electrically Sherardized Steel, Which Is Rust Resisting. The Black Line Indicates the Minute Joint Thickness Between the Metal and Coating—It Having Been Magnified 150 Times.



Where the New Electrically Sherardized Articles Are Treated. This Coating Is Applicable to Threaded Objects As Well As Plain Ones, and Does Not Change the Character of the Material Treated, Due to the Low Temperature Used.

The sherardizing equipment consists of an electrically heated revolving oven mounted on trunnions which are supported in pillow blocks. The oven is rotated by an electric motor geared to the driving shaft. Metallic resistance elements are placed on each side of the oven and current is applied to them thru collector rings. The best formulæ for sherardizing can be carried out properly only in an electric oven where temperature, motion and atmospheric conditions can be perfectly regulated.—*Photos G. E. Co.*

SCIENCE IN MODERN WARFARE.

The Great War has been called a "grand physical phenomenon" and a "battle of the sciences." To the layman this does not mean very much, but it is nevertheless a fact. It could just as well be called a "chemist's war" or an "engineer's war" or a "surgeon's war," so much have the various sciences contributed toward carrying on the war, says L. L. Edgar, in *Edison Life.* Most of us do not think of the part science has played in this great struggle. All we see and read of is the terrible fighting and wastage of human lives. It is very interesting to go into the subject deeper and see what has made possible all this fighting, and just where science and its application has to do with modern trench warfare.

Every known science has played an important rôle, including chemistry, physics, hygiene, mathematics, engineering, geography, geology, metallurgy, geodesy, bacteriology, meteorology, astronomy, and many more of the physical and natural sciences. The war has demonstrated two things: first, that warfare cannot be carried on without the necessary raw materials—that is, chemical, physical and metallurgical supplies; and secondly, it cannot do without the organization of the different scientific elements in connection with the military establishments.

Today one cannot tell whether the next officer he meets was a soldier before the war or a professor of science in some college. Productive brains receive more care and protection now than any other part of the population.

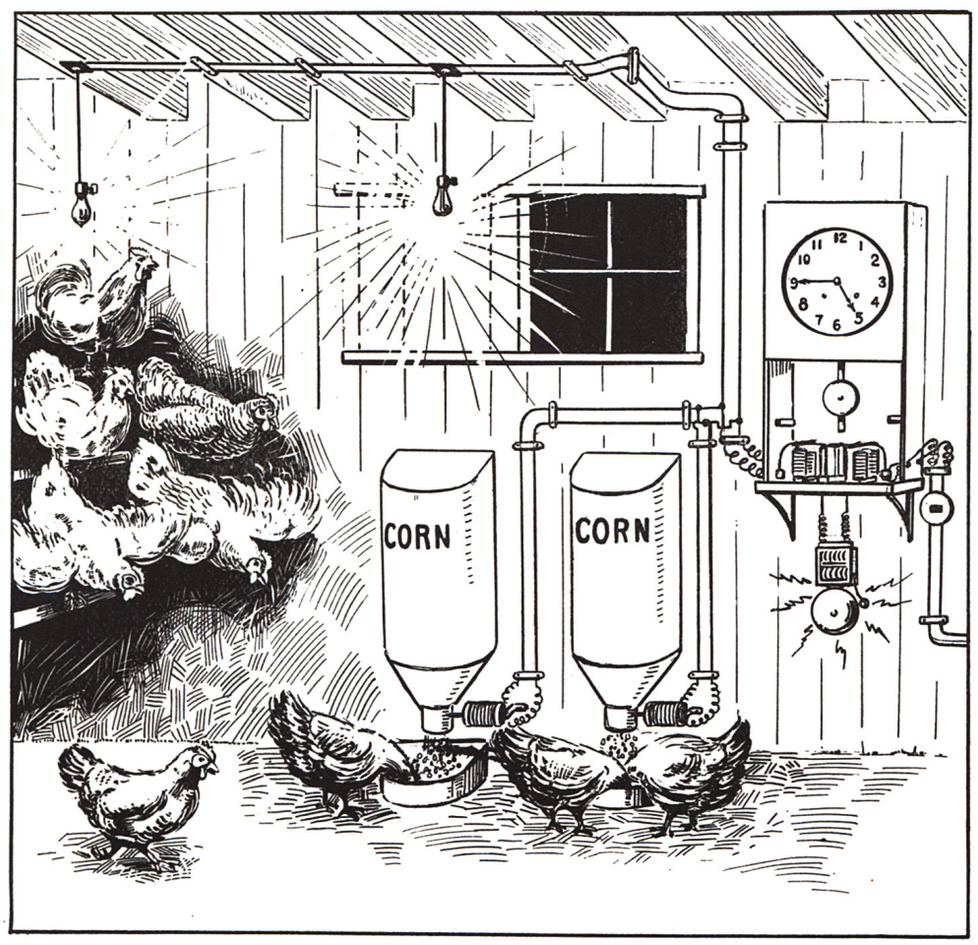
Let us take some of the more important sciences and see what connection they have in waging war. The astronomer has become an important factor in preparing artillery tables and maps and in perfecting instruments. The statistician is very valuable in planning an offensive, as is also the meteorologist. When trenches are dug, the geologist is consulted, as he can tell the best places for shelter, and the probability of striking underground waters. The leader of the war in France, in the person of the minister of war, is a mathematician, and his personal staff are of the same profession.

The science of *acoustics,* about which, up to the beginning of the war, very little was known, has blossomed out into that of the greatest importance. The French have in use several systems of determining by acoustics the position of enemy batteries. It is possible by these systems to tell to within a few yards the position of a gun *fifteen miles away,* to determine its caliber, to tell the difference between the discharge, the flight thru the air, and the bursting. The spot from which a shell was fired has been found before the shell landed and exploded. A battery of French thirteen-inch cannon, mounted on a railway truck, fired four shots at an *invisible target over fifteen*

(*Continued on page* 50)

Electricity Makes the Hens Lay, by Heck!

Can electricity make hens lay more eggs? Yes, say the experts. While in New London, Conn., recently Professor Kirkpatrick and R. E. Jones, of the Connecticut Agricultural college, visited the poultry farm of Morton F. Plant, where electricity is being used successfully in increasing egg production. The success of this plan is owing to the fact that the hens eat more feed and a better balanced ration. Mr. Hoover's secretary please copy!



They Do Say That by Turning on the Electric Lights a While at Night and Also in the Morning, That Chickens Lay Much Better. In One Instance 1,200 Chickens Have Been Successfully Experimented with in This Way.

In describing the working of the experiment, Mr. R. E. Jones said there are 6,000 hens on the farm, 1,200 of which are in the experiment. These are divided into groups of 400 birds each. In the first the birds have electric lights and are fed from automatic hoppers, while the lights are on. The second group do not have lights, but are fed from hoppers, while the third are without lights and fed by hand. The lights are controlled automatically by special electric clocks which it is only necessary to wind twice a week. The automatic hoppers used in the first pen are used only during the lighted hours. At 4:45 a. m. a two-candle-power light is turned on over the roosts, and at 5 o'clock three forty-candle-power lights are lighted in each house. These remain on until daylight and are turned on again at dusk until 9 p. m., when they are replaced by the small lights until 9:15 o'clock.

The greatest increase in production is found in the case of the old hens, it is claimed.

EDISON-TRAINED BULLETS.

Two negroes were walking along the avenue discussing the wonderful inventions brought about by the war.

"Yes, sah," one said, "an' a friend of mine who knows all about it says dis heah man Edison has done gone and invented a *magnetized bullet* dat can't miss a German, kase ef dere's one in a hundred yards de bullet is drawn right smack against his steel helmet. Yes, sah, an' he's done invented another one with a return attachment. Whenever dat bullet don't hit nothin' it comes right straight back to de American lines."

"Dat's what I call inventin'," exclaimed the other. "But, say, how about dem comin' back bullets? What do dey do to keep 'em from hittin' ouah men?"

"Well, mah frien' didn't tell me about it, but ef Mr. Edison made 'em you can bet youah life he's got 'em trained. You don't 'spose he'd let 'em kill any Americans, do you? No, sah. He's got 'em fixt so's dey jes' ease back down aroun' de gunner's feet an' say: 'Dey's all dead in dat trench, boss. Send me to a live place where I's got a chanct to do somethin'."
—*New York Herald.*

Orville Wright is credited with having invented a new type of airplane stabilizer. This stabilizer, operated electrically, uses a pendulum which swings in water.

MARCONI COMING OVER.

It is reported that William Marconi will replace Count Macchi di Cellere, Italian Ambassador at Washington. Count Cellere, it is understood, is returning to Rome and will likely be sent to Petrograd, where Italy is now represented by a charge d'affaires.

Senator Marconi, according to these reports, will go to the United States as Italian high commissioner with the rank of Ambassador.

ELECTRIC "BONES" FOR THE MINSTREL.

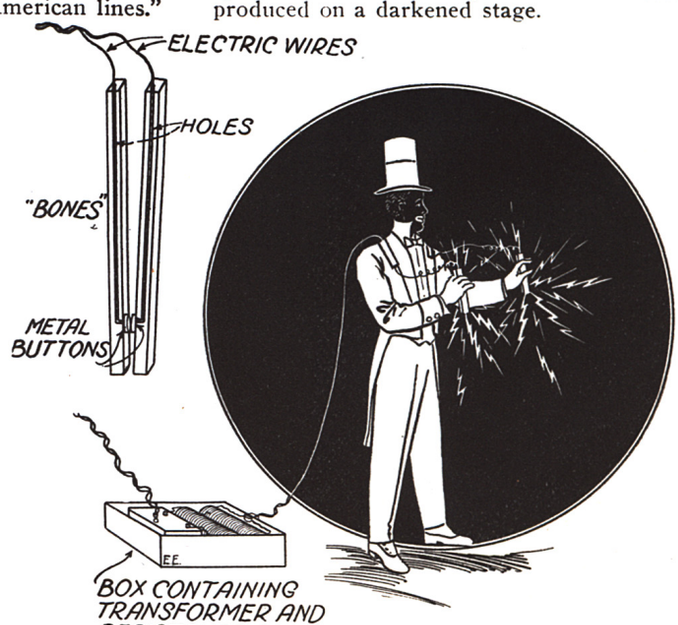
Remember the last ministrel show you saw, when the "end men" rattled their "bones" so delightfully? Sure you do! Well the end men of the next minstrel performance you witness may spring a novel surprise on you, for a New York inventor, Mr. Samuel Sussman, has patented a new kind of electric, fire-spitting "bones," which give promise of being a real novelty in the hands of a good minstrel.

The purpose of this invention is to produce a dramatic lighting effect in addition to the rhythmic sounds produced by the performer with the bones and synchronous with the movement of the same.

In the accompanying drawings are illustrated the general arrangement of the invention. Two electric wires connect with two elongated parts made of bone or ebony or some such hard substance. Thru the center of these, are holes drilled part of the way thru for the insertion of wires. At or near to one end of each of the bones and at one side of each, are attached metal spark electrodes. To each of these metal parts is attached one end of a wire.

A suitable portable box is provided in which are resistance coils and a connecting wire, which wire may be used for connection with the electrical supply. There is also provided a bent frame or collar, composed of metal, which may be covered with rubber or other insulator, to be worn under the coat of the performer and at each end of this collar wires are attached connecting the same with the bones. This collar is also connected by wire with the transformer or resistance coils of the metal case.

In operation the bones are placed, in the usual manner between the fingers, and, the current of the electricity having been applied, the movement of the operator in shaking the bones connects the metal parts, producing, by their contact flashing electric sparks. Needless to say the effect is best produced on a darkened stage.

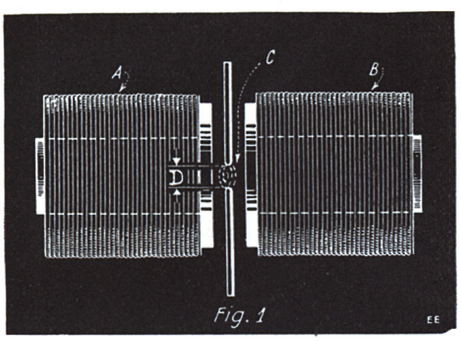


Here's the Minstrel Up-to-Date. He uses Electric "Bones" Which Emit Flashes of Fire at Every Click.

Fixation of Nitrogen by Electricity

By Theodore Bodde, Research Engineer, General Electric Company

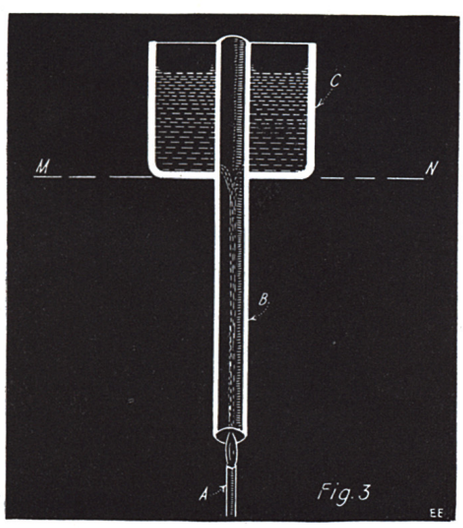
ONE often hears nowadays the expression "fixation of nitrogen." All governments have been busy lately on this nitrogen problem, and it is evident that it must be one of great importance, especially just now in relation to the world war.



Several Foreign Countries, Including Germany, Employ the Birkeland-Eyde Electric Arc System for the Fixation of Nitrogen from the Air.

It seems appropriate therefore to explain to the public the reasons for and the meaning of the expression "fixation of nitrogen." First, just what is nitrogen? Nitrogen is a gas present in large quantities in the atmosphere in which we live. In fact, four-fifths of the air which we breathe consists of the gas nitrogen, and only one-fifth part of it is the precious gas oxygen for which our lungs crave, and without which no life would be possible. This nitrogen of the air can also become precious and useful if we make out of it the powerful explosives used not only for breaking up rocks and mountains, but also for fighting the enemy in war time. Then, too, the innumerable plants in our fields and gardens could not live without nitrogen in their food. Our fertilizers are therefore made principally from that element.

Tho nitrogen is so abundant around us, when in the air it is like a bird in the bush. We can not catch it, for it is extremely difficult to combine it with other elements into useful material. In fact, it is so recalcitrant to any chemical combination, that only very high temperatures or special chemical conditions are able to overcome its independence and "fix" it to other elements. Once, however, that this nitrogen has been "fixt" or combined with another element it can be made easily into a liquid or solid substance, in which shape it can then be handled and transported and done with whatever we please. This is what we call "the fixation of nitrogen."



The Shönherr Electric Process of Fixation of Nitrogen Employs an Arc Twenty Feet Long.

That June "E.E."

As we mentioned in the April issue we are always pleased to hear from our readers. The best constructive letters making practical suggestions for improving the "E. E." will be publisht in the "EDITOR'S MAIL BAG." Write in now and then, readers, and tell us what your ideas are regarding the articles publisht in "your" journal—for your's it surely is. We don't publish it to suit OURSELVES—but to please YOU! Therefore let us hear from YOU once in a while. If you don't like an article, say so. On the other hand, you do YOURSELF and the Publishers an injustice by not telling them which particular articles you find interesting and instructive. Oh! yes! we almost forgot—here's the "advance dope" on that "June" number.

"A 100-Mile Electro-Magnetic Gun that Can Annihilate Cities."

"The Electrical Testing of Coal," by the U. S. Government.

"A New Electric Recording Compass—It Solves Many Navigation Problems," by Prof. Eugene Staegeman.

"New Talking Motion Pictures," by George Holmes.

"The Dynatron—A Remarkable New Vacuum Tube for Radio-Telegraphy."

"Television and the Telephot"—Part II—by H. Gernsback.

"How to Build an Electrically Played Piano"—Part II—by Charles Horton.

"Wave-Meters—Their Uses and Construction"—Part III—by Morton W. Sterns, Radio Engineer.

"Experimental Mechanics"—Part IV—by Samuel Cohen.

"Experimental Electric Furnaces."

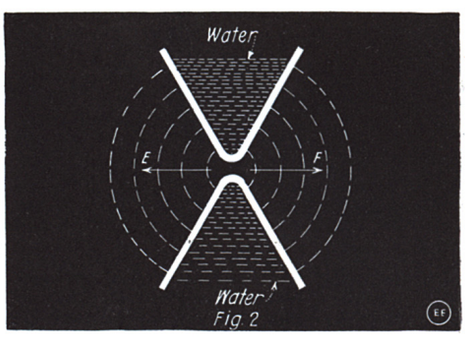
"Experimental Physics"—Lesson 13—by John J. Furia, A. B., M. A.

"Burnt-out Lamp Contest."

"The How and Why of Radio Apparatus"—Lesson 9—by H. Winfield Secor.

This nitrogen which was at first so independent has now become perfectly subdued and ready to combine with any cells of organic substances into powerful explosives like dynamite or into useful fertilizers.

One of the elements with which it can be forced to combine from its original independent state and only under the coercion of an intense heat is the other element contained in the air, "oxygen." Thus as air is a mixture of nitrogen and oxygen, we have only to subject it to an intense heat and the chemical combination of these elements takes place. The result is a gas which we call "nitric oxid." We can say that the intense heat causes the nitrogen to burn up into the oxygen and that the product of this burning process is the gas



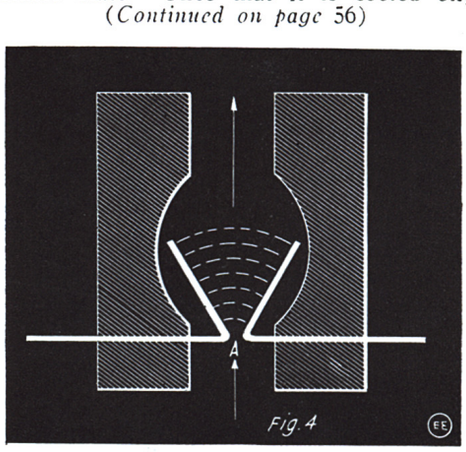
The Electric Arc Used in the Fixation of Atmospheric Nitrogen by the Birkeland-Eyde Process Is Formed Between Water-Cooled Electrodes.

named "nitric oxid." This gas can be burnt still further, forming then a higher oxid of nitrogen and if then past thru water, it forms the well-known liquid "nitric acid," from which most of the other derivations of nitrogen are created.

This burning of nitrogen requires a temperature of about 3,000 degrees Centigrade, and the electric arc has been found almost the only practical means for obtaining this high temperature. If air is made to pass thru an electric arc, the nitrogen combines with the oxygen and forms nitric oxid gas; but while cooling off, this nitric oxid gas dissociates again into its elements nitrogen and oxygen, and nothing is gained in the end. The reason for this is that this nitric oxid gas, tho stable at very high temperatures, becomes very unstable at the medium temperatures thru which it has to pass while cooling off. At the temperature of about 2,000 degrees Centigrade it dissociates readily into its elements. At a lower temperature than 1,500 degrees Centigrade it becomes, however, stable again.

Therefore if one wants to preserve the formed nitric oxid gas, it is of great advantage and in fact absolutely necessary to cool it off very rapidly so that it remains during as short a time as possible in the unstable state. Once that it is cooled off,

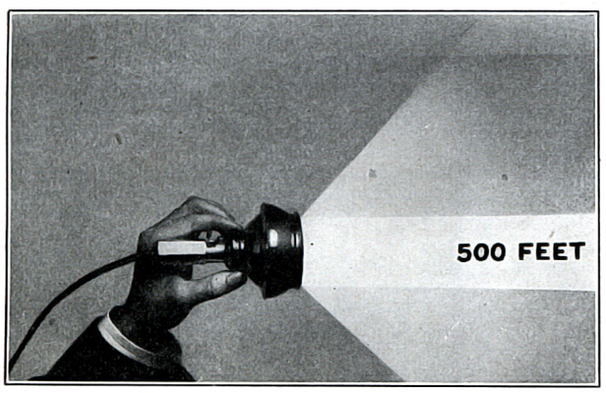
(*Continued on page* 56)



This Shows a Section of the Pauling Nitrogen Fixation Arc Chamber. The Arc Rises Between the Horns, Due to an Air Blast, Breaks, and Starts All Over Again in Rapid Succession.

NEW AUTO HEAD-LIGHT.

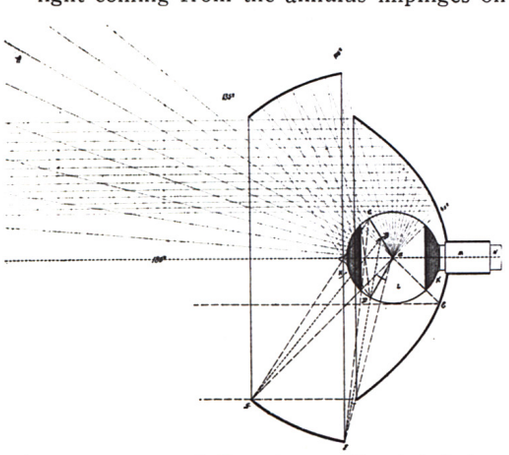
In this new auto lamp here illustrated, the manufacturers have designed an exceptionally powerful projector of compact dimensions, that is capable of projecting not only a projected main beam but also a non-glare general diffused illumination.



A Clever Auto Headlight Which Throws a Powerful Concentrated Center Beam of Light, 500 Feet; the Outer Rays Are Non-Glaring.

As we analyze lamp devices, say its inventors, we find that as it appears to the eye there are two sources of glare, one the filament itself and the other the reflector surface. The inventors argue that coloring the light does not enhance the visibility with reduced glare when applied to a unit source. Neither do they believe in the possibility of prismatical deflection nor that a parabola can have an optically correct relation to a multitude of small prest lenses with a conglomeration of axial alignments and focuses. Therefore the possibilities in glare reduction and still possessing light projection are to minimize the glare due to direct visibility of the light source and to form a main reflector of least aberation and well concealed from the direct visibility.

In this new lamp an attempt has been made to carry out this idea with precision. The light source itself is embraced to the angle of 105 degrees with a spherical curve corrected for aberation and beyond the aperture of the main reflector we have an annulus or spherical curve whose geometrical focus is at an offset as shown in the illustration and therefore the light coming from the filament onto this annulus is not returned on itself but at a distance coinciding with that angle that the frontal screen intercepts. This frontal screen is translucent and light coming from the filament will partly illuminate the same and light coming from the annulus impinges on



Arrangement of Translucent Frontal Screen and Parabolic Reflector to Realize a Strong Central Beam of Light, with Diffused Outer Rays.

the outer surface of the screen; the screen then becomes highly illuminous and is then a source of diffused illumination as well as being slightly beyond the focal point of the main reflector. It also acts as a source of illumination in conjunction with the spherical reflector. The result is a highly efficient projected beam augmented by non-glare diffused illumination.

The inventors have also found that the critical angle reflection for metal reflectors takes place at 52½ degrees. That is whenever a reflector is made to embrace a light source beyond 105 degrees the resultant increase of light flux is a positive detriment to visibility at a distance.

WHEN "UNCLE SAM" TAPS THE WINDOW—YOU LOOK!

This window attraction device is operated by an electric motor and it can be attached to any electric socket, therefore there is no necessity of disturbing your window display when starting or stopping the figure. Its life-like motion of rapping on the window, turning the head and pointing the finger toward the goods displayed, makes it one of the most attractive advertising novelties yet devised.

Rap! Rap! Rap! Goes Uncle Sam's Electric Fist Against the Show Window, and Next Thing You Know You are Buying a New Hat or Suit—or Perhaps a Bottle of Near-Beer.

"Uncle Sam's" clothing may be removed and either a "Santa Claus," "Policeman," or other suit substituted. The heads are interchangeable. It is thus possible to have three distinct characters making an entirely new attraction with each change. The figure stands 27 inches high.

ROME AND WASHINGTON EXCHANGE WIRELESS "TALK."

Direct radio communication between an Italian Government station and the Arlington station of the United States Navy has been established and is being used daily for communications passing between the two governments and between their diplomatic representatives and foreign offices.

The daily statements of the Italian War Office will be received by radio from Rome and issued here for publication in the United States.

NEW ELECTRIC SHAVELIGHT FOR SOLDIERS.

It throws a flood of light—not in the eyes, not into the mirror or around the room, but on the face, right where you need it.

For the Boys in the Trenches or in Camp, There Is This New Electric Shavelight. It Carries Its Own Battery and the Lamp May Be Used Separately When Desired.

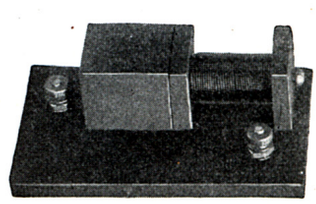
The soldier's days are busy. He must shave, usually at night. And it's not to be expected that his quarters—often an old barn, farm house, etc.—will be equipt with "all the modern conveniences." He will, therefore, find this new military style electric light shaving outfit very serviceable.

The outfit consists of a high-grade safety razor, with six crucible steel blades; the electric light attachment that attaches to razor handle; stropper; battery that will supply light for one-hundred shaves; high quality aluminum trench mirror—all complete in a compact khaki case. The light attachment can be used on fountain pen or pencil for writing where light is dim or wanting—also for reading.

An electric apparatus has been devised for giving warning of impending air raids. It is claimed to be especially applicable to factories and public buildings. An electric resonator is placed on the roof, and on the sound of a given pitch being produced, the resonator causes a bell to ring in the building until it is stopt. It is said that large areas can be simultaneously and instantaneously warned.

A TOY CIRCUIT-BREAKER.

The accompanying illustration shows a toy circuit-breaker for protecting all types of toy transformers against injury from short-circuits. It opens the circuit automatically, and can be closed by push-button only when the cause of trouble is removed. It is low in cost and will be found of interest and service to the junior engineers



The Youngsters Who Operate Miniature Electric Trains and Motors Will Like This Little "Circuit-Breaker."

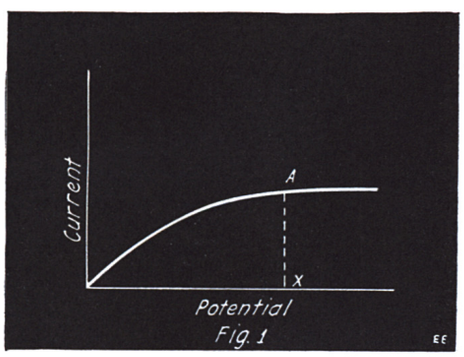
and electricians who operate miniature electric railroads, motors and other various small electrical devices requiring some form of protective apparatus.

The Phenomena of Electrical Conduction in Gases

Part II. How Fast Ions Travel

By ROGERS D. RUSK, M. A.

IONS may sometimes travel at almost infinitely high speeds. The velocity of these little electrically charged particles depend largely upon existing conditions, but may sometimes be as high as the velocity of light itself. This indicates that there is enormous energy back



Graphic Curve Showing How the Current of Electricity in a Gas Reaches a Maximum or "Saturation Value" at a Certain Potential.

of these particles, and if we experiment a little we may find this energy doing strange things.

For instance Franck and Hertz, two modern physicists, have recently discovered that when a gas is ionized, light may be produced when the ions become charged, Franck and Hertz worked mostly with mercury vapor, and when they raised the potential thru the vapor to 4.9 volts per centimeter, between the electrodes, they found the vapor gave off a certain amount of ultra-violet light. When they increased the potential to 12 volts they discovered that just at that point a great deal more light was given off. The first voltage evidently marks the point at which ionization begins and ions receive a *single* charge. The second voltage evidently is the potential required to give the ions *multiple* charges, and in each case charging an ion causes the *emission of light.* This is quite in keeping with the electro-magnetic theory of light, and the modern belief in the electric theory of matter, for when the electric charge jumps to the ion the electro-magnetic disturbance in the ether is started. This kind of light may be called *cold light,* as an increase in the potential from 4.8 volts to 4.9 volts makes little change in the temperature of the vapor, for at the former point no light is given off, while at the latter it is.

If some substance other than mercury could be found, giving a greater emission of light, the whole lighting industry might be revolutionized and instead of using incandescent lamps, which waste the most of their energy in the form of heat, we might have lamps operating on *low potentials* and giving off *little or no heat at all.* The nearest approach to such a light today is the Moore vacuum tube light which works however at a very *high* potential.

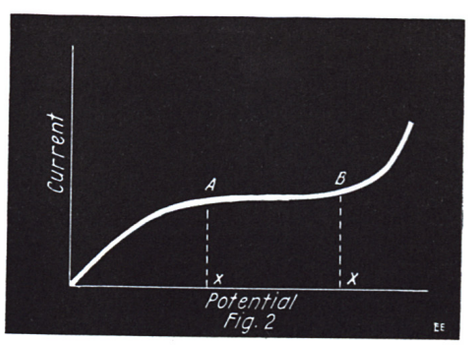
The great variety of speeds which an ion may have depends a great deal on the fact that we may have the following four general classes of bodies in an ionized gas.

(1) single electrons.
(2) charged molecules.
(3) charged clusters of molecules.
(4) neutral or uncharged molecules.

The latter may become charged at any time by *ionization* thru the agency of heat, X-rays, radium, ultra-violet light, or collision with each other. The existence of such ions may be proved by demonstrating the conductivity of the gas, and they may be removed from the gas by *straining the gas* thru a glass tube fitted with a plug of glass wool, or by bubbling it thru water. It will then be found to be *unionized* and *nonconducting.*

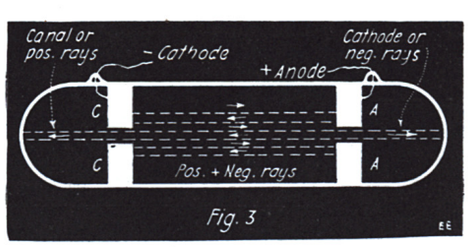
Straining the ions out makes it seem as if the ions must all be larger than the gas molecules which get thru, but this is not necessarily the case as it is most likely their *electric charges* which make them stick to the glass wool or remain in the water.

It may be well to notice, before going any farther, a very great difference between conduction of electricity in gases and conduction in solids or liquids. The amount of current which may pass thru a conducting liquid or metal varies with the resistance as per Ohm's law, $C = \frac{E}{R}$. However this



This Curve Shows How the Current in a Gas Behaves When the Potential Is Further Increased Past the "Saturation Point."

is only *partially* true with respect to gases. The higher the voltage, the more the current falls *below* the value it should have by Ohm's law, until such a point is reached that an increase in the potential does *not*



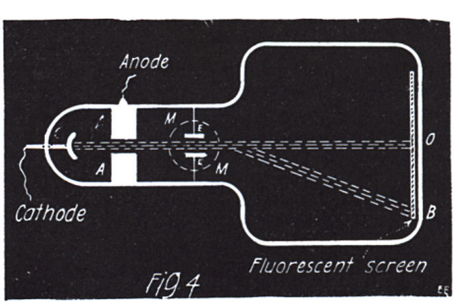
An Interesting Vacuum Tube Which Separates the Positive and Negative Ions in a Gas When Connected to a Source of Electric Current as Shown.

increase the current at all. At this point the current is called the *saturation current,* because all of the ions are being carried out of the field, as fast as they are formed. Hence this is a maximum value for the current. Its meaning can best be understood from the curve, Fig. 1, representing the variation of the current with an increase in potential. The current as will be seen rises rapidly at first, but soon begins to slow down and at last reaches a steady value at A where the slope has become zero. The current then in a gas depends upon the total number of ions being formed in the gas. However, a very interesting phenomena is noticed if the potential is raised a great deal higher still than its value for saturation. At a certain point the curve will begin to rise again showing that contrary to expectations the current, after having seemingly reached a maximum, is now increasing again. The complete curve will now appear as in Fig. 2, where the second increase is found to occur from B-X on. This is due to the fact that when the potential is raised to a much higher value, the existing ions are swept across the field so fast that they encounter neutral molecules in their flight, and ionize them by collision, thus producing fresh ions, and thereby increasing the number of carriers for the current.

In measuring the *velocity* of the different kinds of ions the first necessary step is to separate the *negatives* from the *positives.* As the first measurements were made on ions in vacuum tubes, this can be easily accomplisht by such a tube as shown in Fig. 3. The rays between the cathode C and anode A, are a mixture of both *positive* and *negative* ions traveling in opposite directions. However, if each electrode is perforated with a small hole near the center it will be found that some of the positive ions formed at the anode will travel thru the perforation in the cathode into the space beyond it; while the same thing is true of the negative ions formed at the cathode, some of them will be projected thru the opening in the anode into the space beyond. So far, it has been found that the *positives* travel with a comparatively slow speed while the *negatives* may even travel as fast as 186,000 miles per second.

There is a certain class of modern scientists who believe this velocity is the highest possible velocity that anything may ever have. Those who believe this are the upholders of the *theory of Relativity.* They hold that such realities as time and space cannot exist independently of each other, but are connected by a very close relationship (hence the name *Relativity*). They say by this relation everything else in the universe is conditioned, and that no velocity can exceed the *velocity of light,* which is the swiftest form of energy known traveling in the lightest medium, the *ether.* As this theory has met with a great deal of criticism it is probable that the question will remain open for some time as to whether a higher velocity is possible or not. However, it is interesting to note that the velocities of the ions do approach this value seemingly as a limit. Also this may tend to show that the fastest ions after all are nothing more material than light itself, altho we call them unit charges of electricity.

(*Continued on page* 57)



Thomson's Famous Vacuum Tube for Measuring Velocities of Ions in a Gas.

Capt. E. H. Armstrong "Over There"

ALL American radio men are acquainted with Edwin H. Armstrong, the young genius who devised and patented the now well-known "Armstrong Circuit" for Audions, by which it became possible to make a single bulb regenerate or develop

Captain Edwin H. Armstrong, U. S. Signal Corps, With the American Overseas Forces in France. He is the Inventor of the Now Well-Known and Widely Adopted "Armstrong Circuits" for Audion Receivers.

radio-frequency oscillations. so that undamped, as well as damped, waves could be received and amplified.

We are pleased to reproduce a photograph of Mr. Edwin H. Armstrong, the well-known American wireless expert, who was awarded the medal of the Institute of Radio Engineers for his discoveries in the radio art. Such an award constitutes in itself a recognition of genuine service in the cause of radio science. Mr. Armstrong was born in the United States on December 18, 1890, and after passing, with credit, thru the usual school curriculum graduated at Columbia University, from which he obtained his degree in 1913. Since that date he has concentrated his efforts on the advancement of radio-telegraphic science, working in conjunction with Professor Pupin, the President of the Institute of Radio Engineers, in his important research work at the Columbia University laboratories. Mr. Armstrong is himself one of the Directors of the Institute of Radio Engineers, besides occupying the post of President of the Radio Club of America.

Like so many other of his fellow citizens, he has answered the call of his country to aid her in the *rôle* she has undertaken in the present struggle, and recently received his appointment as Captain in the U. S. Signal Corps. This young scientist of twenty-eight has already won high distinction by his work in wireless telegraphy. Perhaps the invention most widely connected with his name is that of the "Armstrong Circuits," which have done so much to improve the sensitiveness to reception of wireless apparatus through the instrumentality of the three-electrode valve. Mr. Armstrong has thrown much energy and zeal into the work of the Institute and has made many valuable contributions both to its discussions and its Journal.

Captain Armstrong is now in France with the American Expeditionary Forces. His skill in the radio art will prove of supreme value to the American army.

RADIO SAILORS GET INTO TRIM FOR SEA DUTY.

The accompanying photo is an unusual interior view of the new Austin Hall operating rooms at the Harvard Radio School. Time and especially war will change all things. This room was formerly in more peaceful times, a part of the Law Library study at Harvard. Here the radio operators which are to man Uncle Sam's rapidly-growing battle fleet are taught the science of wireless by experts, many of whom were well-known radio workers in civilian life prior to the declaration of war against the Central Powers. Now one hears the constant buz-buz of the radio-telegraphic dots and dashes all day long. The men are not kept at code practice all day long—but as fast as one class finishes its period, another takes its place. Thousands of future naval Radio operators are being taught how to handle wireless apparatus and how to send and receive the mysterious dot and dash messages at this school. Today a battleship, or any vessel of the line, would be practically "blind" without its Radio equipment and squad of Radio operators—three to six of whom are supplied to each war vessel.

UNIVERSITY OF ILLINOIS OFFERS WAR COURSES.

A war course in Radiotelegraphy is being offered by the electrical engineering department of the University of Illinois to junior and senior students of this department as an elective. An oath of secrecy and appearance before a notary public by those entering the course, vowing that they will in no way divulge any facts learned in the course to any persons other than Government officials, is required. Apparatus for receiving messages (the receiving sets alone being furnished), with confidential information and instructions for their use has been loaned the University by the United States Signal Corps, Prof. Ellery B. Paine, head of the department of electrical engineering, is the instructor in the course.

The department of geology is also offering an interesting course, dealing with the iron and coal factors in the warring nations of Europe, lines of communication and other topics concerning the geography and geology of the war theater. The University has pledged itself to instruct 5,000 soldiers, either engineers or regular soldiers, for skilled war service in the departments of mechanical and electrical engineering, including laboratory and shop practice. Announcement has also been made that the ground school of the work in military aeronautics will be doubled in size, providing accommodations for 1,200 students.

Speaking about the capacity of condensers, are you aware of the fact that the entire capacity of the earth is only .707 microfarads?

A "Code" Class of Uncle Sam's Naval Fighters at Austin Hall, Harvard Radio School, Where Thousands of Students Are Being Trained.

RADIO TAUGHT IN NEW YORK TRADE SCHOOL.

There is a great demand for radio men in the Signal Corps and to meet this need classes have been formed in many parts of the country. One of the most interesting in New York City is that held at the Stuyvesant Evening Trade School. Only men who will be called in the second draft and who have been examined and placed in Class 1 A are eligible.

As these men are still earning their bread and butter, they can only do this work in the evening. Despite of this fact the results are exremely good. The men are heartily in earnest and eager to gain the required proficiency of sending and receivnig 20 words per minute. This is the standard speed set by the Signal Corps. Thru the patriotic devotion of the instructors it has been found possible to have these evening classes free.

The equipment used in teaching the radio classes is of the best and very latest type. The head-bands are of the new single bar type widely used in the government sets and weigh less than any other style so far designed. The tone buzzer used is a new design giving the true 500 cycle spark pitch, so that the students are trained under as near working conditions as possible. This is more important than it might seem at first, for if the student is accustomed to hearing the signals on a low pitch tone he is very liable to be confused when he first hears a "real" wireless signal coming in on a high pitch note.

In an interview with Mr. T. H. Knox, principal of the school, as well as Jacob Weiss, Head Instructor, we were informed that the instruction is entirely free, all apparatus being furnished. All the drafted Class 1-A men are eligible, and all those that are subject to call. The school can still accommodate a few more men.

We see no reason why wireless amateurs should feel discouraged on account of the closing of their radio stations. To us, we see a chance for the amateur to fix up his set to perfection, study up his theory, and when the war ends be ready to do efficient work.

Wireless communication was first established between Japan and the United States, July 27, 1915.

NEWS OF BUENOS AIRES-NEW YORK RADIO.

By León Girerd.

I AM pleased to inform the readers of the ELECTRICAL EXPERIMENTER of the progress of wireless telegraphy in this country.

In the first place, we have the arrival of the American engineer, Mr. Charles Edbridge, who comes to direct the work of installing an ultra-powerful radio-telegraph station for direct communication between Buenos Aires and North America, the concession having been granted to a North American company a year ago. This plant will be installed in San Isidro (near Buenos Aires), and the plans have already been approved by the government. Recently, however, some modifications have been suggested. The original plan called for the antenna to be sustained by three towers 300 meters high (about 1,000 feet), but in the modification two have been suppprest. The transmission system will be such as is used in nearly all of the large stations—Poulsen 500 kw., length of wave 24,000 meters. Altho there is no station in the city, it will have direct communication with the offices which will be established in the central boro. The price of this station is calculated to be $750,000 (American currency).

It is also worth mentioning the attempts that have been made to communicate with Nauen (45 km., from Berlin). The interested parties secured a three months' authorization to erect a station which they placed on "La Florida" farm in the Plomer station. The characteristics of this station were as follows: the most modern type of receiving apparatus was used, including a *Lieben valve;* the copper wire antenna was sustained by 16 posts, 32 meters (105 feet) in height, and a wave length of 3,000 meters; the *ground* constituted a network of iron wires, 800 meters (about 2,600 ft.) long, interred in the form of a fan at a depth of 1 meter; the antennae has the same reach toward the east as that of Nauen; taking into account the distance between Nauen and Buenos Aires, which is in a direct line, 13,000 kilometers, there are various difficulties.

Notwithstanding these difficulties, the constructors have been able to get into direct contact with Nauen, but owing to the great atmospheric discharges (static), have not been able to decipher the messages; these discharges are due partly to the form of the antennae, which, because of their length and height, cut thru various atmospheric strata, producing violent discharges which disturb the reception.

Nauen has a power in the antennae of 200 kw. and a wave length of 12,600 meters. (Before rupture with the United States, it was supposed to be 300 kw.).

At the end of the three months, the constructors asked the government for an extension of time of one month, stating that they had not been able to communicate owing to the fact that they did not know the exact time when Nauen transmitted with entire power. We note that this is not true. After several days delay, the Secretary of the Navy appointed an engineer to investigate and determine as to the probability of their having received messages from Nauen. The report was unfavorable, and he ordered the dismantling of the station.

It is probable that they were able to receive perfectly, since in 1914 the "Cape Trafalgar" could communicate with Nauen from S. de Bahia, Brazil. At that time the

(*Continued on page* 53)

WOMAN OPERATOR IN THE U. S. COAST GUARD.

Yes, the women are bound to get to the front in this war. Here we have Mrs.

Mrs. Myrtle Hazard, Hailing from Baltimore, Md., a Hale and Hearty Radio and Morse Operator, Now in Uncle Sam's Coast Guard Service.

Myrtle Hazard, who is from Baltimore and the only woman electrician in the United States Coast Guard. She is one of the few women radio operators in the government service. She learned the job in four months' study at a class in the Baltimore Y. M. C. A. and past the difficult government examination easily. She is both a Radio and a Morse operator.—*Photo Harris and Ewing.*

Photo © by Press Illustrating Service

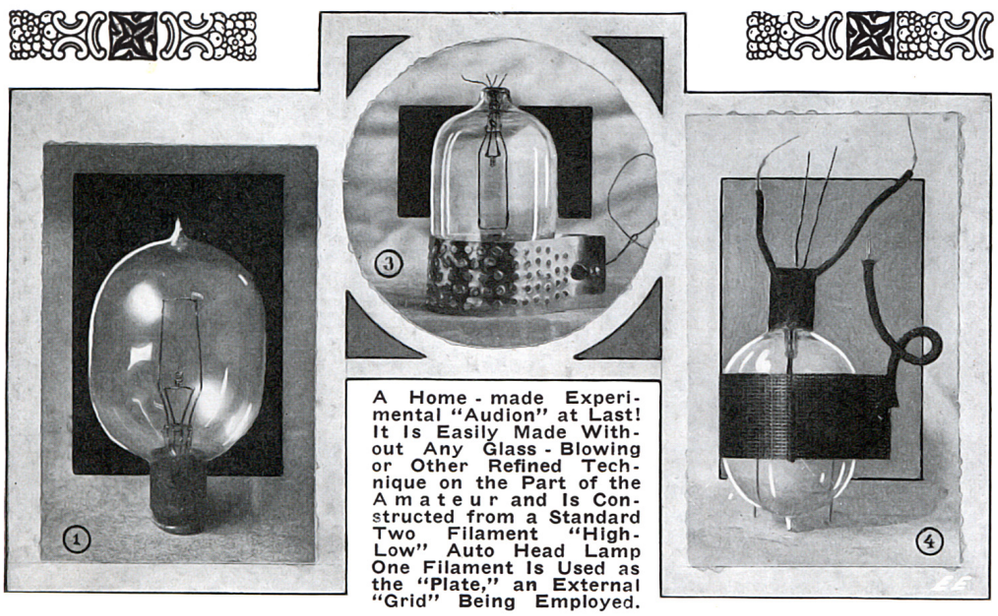
A Busy Radio Class at the Stuyvesant Evening Trade School, New York City, Where Draft Registrants in Class A1 Are Eligible for Free Instruction.

External Grid Vacuum Valve Construction

A Unique and Simple Means of Making Experimental Amplifiers

By R. U. CLARK, 3rd

SINCE the introduction of the first real practical hot filament detector into the radio field, it has been the one great ambition of every wireless amateur to construct experimental vacuum valve detectors for personal use. Sad to relate but very few workers in the past have had the means necessary to perform much research work in this branch of the art, owing chiefly to the expensive apparatus required for the actual construction of the bulbs.



A Home-made Experimental "Audion" at Last! It Is Easily Made Without Any Glass-Blowing or Other Refined Technique on the Part of the Amateur and Is Constructed from a Standard Two Filament "High-Low" Auto Head Lamp One Filament Is Used as the "Plate," an External "Grid" Being Employed.

It is regrettable that the above should be the case—especially in view of the fact that the particular instrument under consideration may still be considered in the embryonic state, and quite capable of being vastly improved.

The present high cost of all good detectors of the valve-amplifier type precludes the possibility of their being used, in furtherance of new ideas, except by those with money to spare, and in most cases places them beyond the reach of many earnest workers.

After a considerable expenditure of time and money, the writer has evolved a very simple and inexpensive method of making experimental vacuum valve detectors, of the external grid type, which will be explained at length in this article. It is the hope of the author that the idea involved, which has been thoroly proven, will be of great interest to a large class of readers. Certainly no one field offers more opportunities of interest to experimenters than the one in mind.

Considerable incentive and encouragement may perhaps be found by others in the fact that, altho the direct outcome of no little work, the actual discovery of the double filament bulb, that plays the all-important part in making our experimental detectors, was the result of chance. During a few minutes' respite, spent in looking thru a motor magazine, the writer became aware that the solution of the problem of making valves was staring him in the face in the guise of an *auto head-light bulb with two filaments.*

It often happens that such discoveries are the result of chance, but the fact remains that unless the particular finding fits in with the line of work being undertaken at the time of enlightenment, the incident will be forgotten or prove of little use. The author—and probably many others—had often thought of using the "High-low" type of electric light bulb for constructing valve detectors, but had always given the idea up as impractical. It remained for the urge of real necessity to demand that every possible means be given a thoro trial.

As may have been already surmised, the real workable valves which are illustrated in the views accompanying this exposition, are not only of the external grid type, but also have two filaments, and thus giving double life to the instrument. It will be at once apparent that, since the bulbs contain two separate filaments and circuits within them, that one is to be heated by the low voltage battery, and the other is intended to constitute the plate, and when used as such its two wire leads will be short-circuited. When one filament has burned out in use it will be reconnected to form the plate, while the other filament, formerly acting as a plate, will furnish the heat necessary to throw out the stream of desirable electrons, on which the whole action of the device depends.

In the first illustration there is shown a view of the "High-low" auto head-light bulb which does the trick. This lamp should be purchased in accordance with the following specifications, and if not obtainable at any of the big auto supply houses in the reader's home town, they can be had from the makers or others as listed elsewhere in this issue.* The bulb which the author, after many tests, has found best suited to the peculiar requirements of the valve detector is rated as follows:

Maker's Number	Volts	C.P.
T 14	6-8	4 & 12, also 12 & 18 C.P. semi-tubular in shape,

with double-contact bayonet base. Usual retail price 80c, with 35% off on lots of 5, making the price 55c each.

Unless these lamps are specially ordered from the makers, and specified in this case "without bases," it will be necessary to carefully remove the brass ferrules and sealing compound, which together form the lamp base, after first cutting the connecting wires away at the contacts to which they are soldered. This work is best done with a small file and a pair of nail scissors, or pincers, and much caution should be observed to prevent accidental breakage.

It will be taken for granted that the experimenter intends to prepare more than one bulb for the initial try-out. Altho there may be a slight difference noticeable in the behavior of different lamps of the same make, the variation will be found in most cases to be very slight. The first bulb tried out, however, might be defective; hence the advisability of using more than one lamp in testing out the idea involved.

A word at this point in regard to the operation of the valves under consideration may save much trouble later on in the game. A good deal has been said against the hot filament detector which is manifestly undeserved. It has been repeatedly stated that, unless exhausted of air to a very exact degree, devices of this nature will prove worthless as detectors. Quite naturally, this is true to a certain extent, but it is often possible to obtain almost equally good results from valves which may vary in this particular, provided the operator is willing to work to find the optimum point of filament luminescence and high voltage adjustment, as required for the utmost sensitiveness under varying conditions of vacuum within the bulb at hand.

Another point worth mentioning is that of the strange and oftentimes erratic action of this class of detectors after they have seen considerable use, which calls for the same solution as above stated. The fact is that probably no one thoroly understands these bulbs as yet.

Before fitting up the lamps as detectors, the wires which lead to the inside should be tested for a possible short-circuit which must, of course, be avoided, except as explained elsewhere. In order to gain a clear conception of the new bulb circuits, which are to be obtained by rearranging the filament leads, the reader is asked to refer to the diagrams in Fig. 2. In this drawing the view *A* represents the original connections as made by the manufacturers. At the point 1 in this view the wires should be disconnected. At *B* and *C*, same figure, the correct wiring plan for using the upper and lower filaments respectively, at incandescence, is shown.

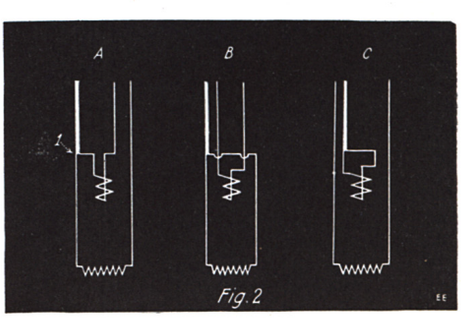


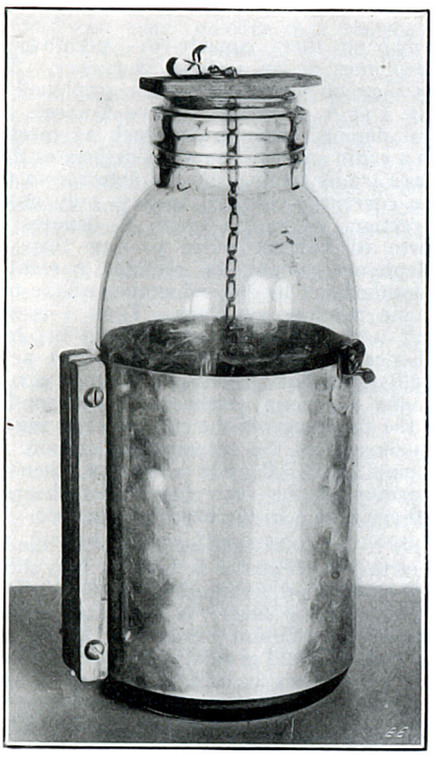
Diagram Showing How Two Filaments in the "High-Low" Auto Head Lamp Bulb are Connected to Give Two Different Forms of "Plate" Element.

*Send stamped self-addrest envelope to the editor and names of concerns supplying these lamps will be sent gratis.

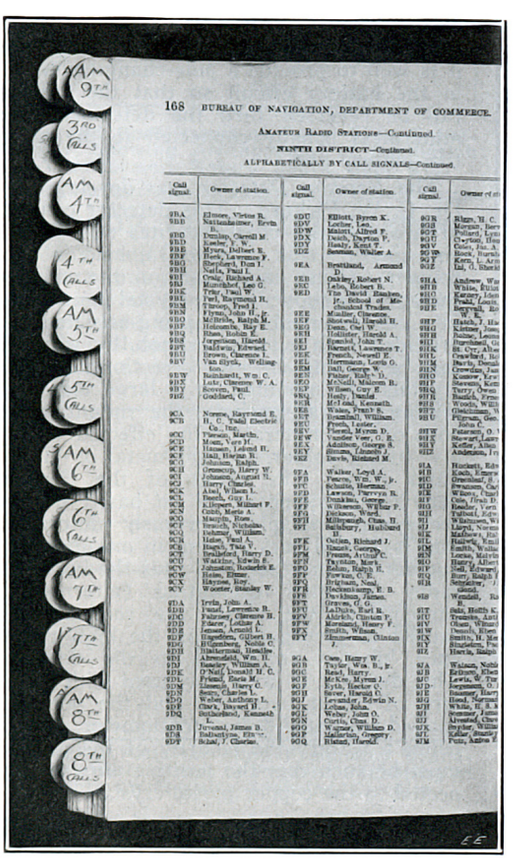
(*Continued on page* 58)

INDEXING RADIO CALL BOOK.

Very little explanation is required. The illustration shows a method of "tab" indexing the "Official List of Radio Stations of the United States" (or any other similar book of reference) to make consultation quick and easy. These index "tabs" can be brought in any first class stationery store for 10c a box.



This Professional Looking Leyden Jar Condenser, Suitable for Radio Transmitters, Is Made From a Good Grade Glass Jar Filled With Salt Water, and Having for Its Outer Electrode a Piece of Tin or Copper Firmly Clamped Around It.



To Index Your Radio Call Book or Catalog, Go to Your Stationer and Ask for a Box of "Thumb Index Tabs," Here's the Result.

A high duty Leyden Jar.—This shows how I made a transmitting condenser (or Leyden Jar) by clamping a jacket of sheet tin around the outside of a gallon bottle. The bottle is filled with salt water and a brass chain let down in it. The capacity is variable thru using a greater or lesser amount of water. Very good for a make-shift, as it took only about an hour to rig up four of them. Some light-gage tin, some 1½-inch stove bolts and some ½-inch by ½-inch pieces of wood, spring binding posts and chain and bottles constitute the necessary material, and they are easily obtainable.

Contributed by W. ROSS McKNIGHT.

MINERALS FROM BROADWAY, NEW YORK.

"What you can't get in New York, you cannot get the world over," is one of the proverbs of New York. While many curious things are found along Broadway, it will probably come as a surprise to many, that Broadway is one of the most curious mineral centers in the world. Very few people realize that on Manhattan Island over 118 varieties of minerals have been found—not only minerals, but real gems.

For instance, on Broadway and 157th Street, there have been found aquamarines weighing 1½ karats. From this locality also come brown tourmaline, golden beryl and rock crystal, which can be cut into gem stones. Of particular interest to the electrical man is the fact that on Broadway and 176th Street there are found, besides beautiful green tourmaline gems, magnetite and iron ore, chalcopyrite, malachite and pyrrhotite, also a source of nickel in a crystal form, which is considered quite rare in any locality.

Many other rare minerals in addition to the few listed are zincite, used in the manufacture of the perikon detector; also the lead mineral roeblingite. Other minerals of interest found along Broadway are agate, amazon-stone, amber, amethyst, chrysoberyl, fire opal, garnet, peristerite, prehnite, rock crystal, rose quartz, smoky quartz, precious serpentine, tourmaline and willemite. The commercial minerals include silver, lead, zinc, copper, iron, feldspar, molybdenite—which is used in the molybdenite detector—grafite, asbestos, mica and beryl. The radio-active minerals autunite, torbernite and uranite are also noted. Also a very good grade of iron pyrite called commonly "fool's gold" has been found in fair quantities in the upper parts of Broadway. Iron pyrite, as is well known, is an excellent mineral for detecting radio signals.

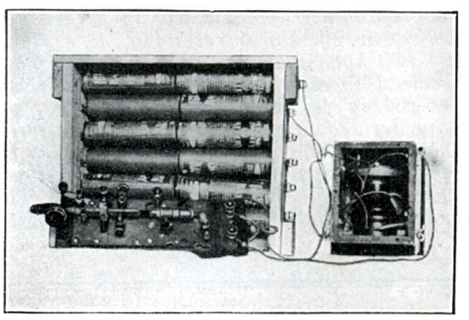
FREAK OF RADIO

A peculiar phenomena which has never been explained well is that which takes place at several points along the Atlantic Coast. There are times when a vessel is in radio communication with another and the signals gradually die out and then increase to their normal sound. A similar effect has been noted by amateurs, who, when sending in one direction can cover *much* greater distances.

Zeppelins can attain a height of 18,000 feet, or about 3¼ miles. They easily remain in radio communication with their home stations.

MICROPHONE "HOWLER" FOR CODE PRACTISE."

Herewith a photo and wiring diagram of three handy pieces of "BUG" laboratory apparatus showing what can be done with odds and ends of a wireless experimenter's assortment of instruments which are now idle. It consists of a telegraph key made on the prinicple of a VIBROPLEX, and it works, too, having tried it out on long telegraph lines of the A. T. & T. and Central Union Telegraph Co. A handy box for holding flash light batteries, so that connection may be made from each pair of cells, spring clips can be seen at the end of the box, for each pair of batteries, both ends have these spring clip connectors.



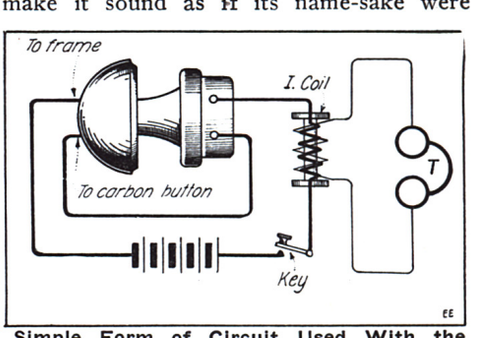
This Genius Has Built His Own "Hy-Tone" Microphone Howler for Practising the Code. By Varying the Distance Between the Microphone and Receiver the Note Produced Can be Changed as Desired.

The box now has a capacity for 24 cells but only 12 have been placed in it. This gives me a range of voltage from 3 to 30 at the present time.

Best of all is the contents of the small box, a telephone transmitter, telephone receiver placed rigidly in an extension telephone bell box, and made into a "howler" in imitation of the Sayville, L. I., station wireless tone. It gives a remarkably clear, shrill tone of a frequency of 500 to 800 cycles, depending on the distance the receiver is mounted from the transmitter, the transmitter being solidly mounted in grooves cut in the edge of the box and the receiver mounted on a screw, similar to the method used in adjusting the magnets of a telegraph relay.

Several "wireless bugs" have listened to the tone of this "howler" and pronounced it an excellent reproduction of the Sayville tone. A home-made induction coil made on one bobbin of a buzzer, and wound with a resistance ratio of 1 ohm to 50 ohms, is connected in series with the battery and transmitter-receiver and the receiver connections are taken from the secondary winding of the coil as shown in diagram. When telephone receivers are being used, the box is packed with cotton and a lid put on it so the sound of the "howler" will only be heard in the 'phones.

The ratio of the resistance of the windings of this induction coil is not according to Hoyle. I found that I only had that much wire to put on it, but a pair of receivers on the secondary winding gives the proper amount of tone to the receivers to make it sound as if its name-sake were



Simple Form of Circuit Used With the "Microphone Howler." The Inherent Instability of All Microphones Gives Rise to a Musical Note of 500 Cycle Pitch, Due to the Reaction Between the Microphone and Receiver.

really coming in. The "bug" key can be made from odds and ends which most every amateur has in his work shop and it surely beats sending with the old style key.

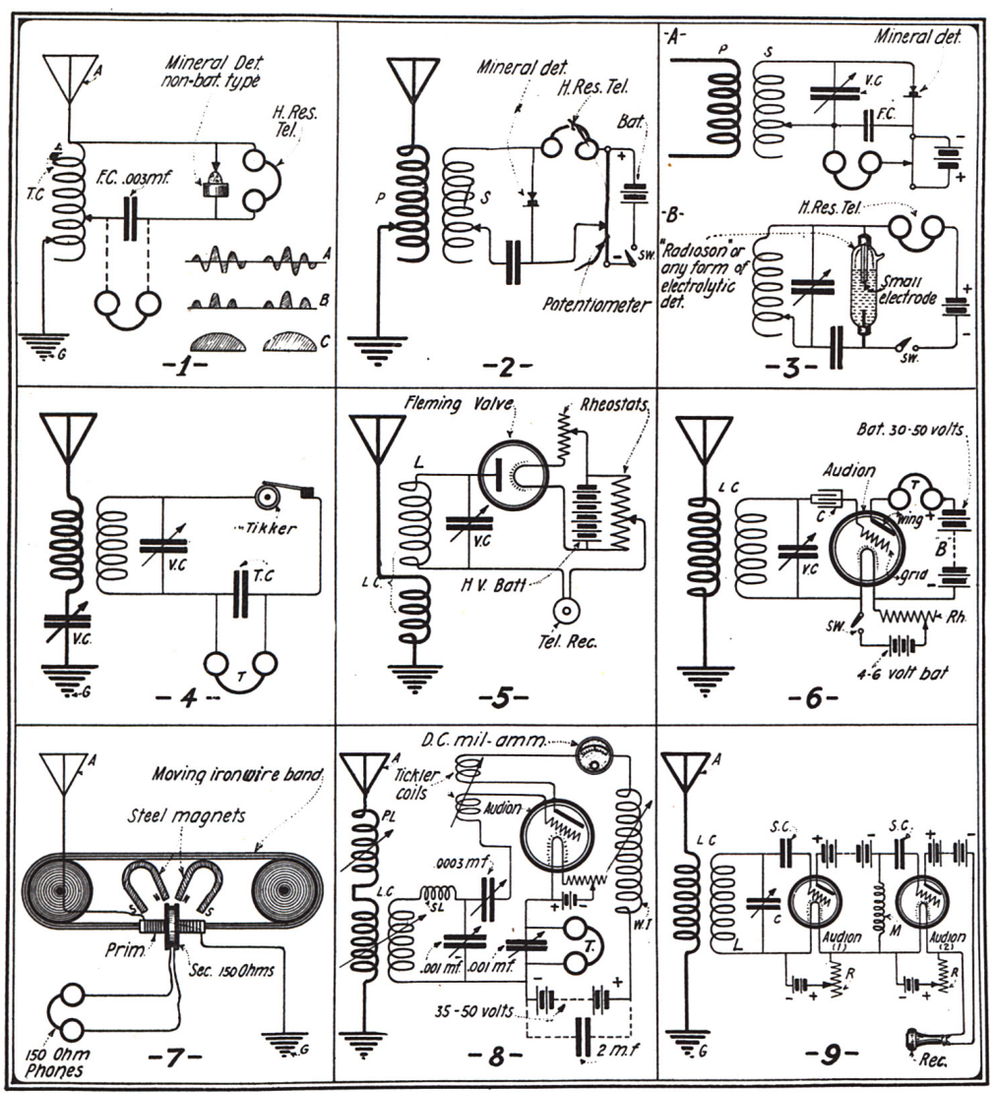
Contributed by CECIL A. RICH.

The How and Why of Radio Apparatus

By H. WINFIELD SECOR, Assoc. I. R. E.

NO. 8—DETECTORS.

From time to time we will describe one particular instrument used in either the radio transmitting or receiving set, explaining just how it works, and why. We have received so many requests from new readers asking for such explanations that we have decided to publish this matter in serial form. In the course of several issues all of the principal transmitting and receiving apparatus will have been covered. The subject for the eighth paper is DETECTORS.



The Principal Types of Radio Detectors Are Here Illustrated and Described. The Detector Is One of the Most Important Apparatus Used in Receiving and Translating Wireless Messages and Should Be Very Carefully Studied.

In all modern radio receptors, especially in those sets used by the army and navy, the *detector* is one of the most important parts of the whole equipment. It has been developed and refined until at the present time it is quite a respectable instrument so far as its efficiency is concerned. The detectors now in use classify broadly into three groups, viz: mineral rectifiers (without battery); mineral rectifiers (with battery), and vacuum valves. Each class of wave interceptor and translator seems to fulfill certain requirements best. Where the vacuum valve would prove too sensitive and delicate, as in mule pack sets, etc., the mineral type detector proves best. Where the radio set is subject to fair treatment the vacuum valve or Audion detector proves feasible. For trench and field work the mineral detector is pre-eminently the type to use; it is at once rugged, simple in operation, always reliable, easily repaired, and last but not least, it requires no battery. An Audion detector is, on the other hand, liable to breakage, disarrangement of the electrodes, requires frequent adjustment, and must always have a fresh battery to light the filament, besides a 40 to 60 volt dry-cell battery for the wing circuit.

The minerals most in use as rectifiers of the high frequency oscillation groups are the following: Steel point-carborundum, gold or steel point-silicon, gold or steel point-iron pyrites, metal or grafite point-galena, zincite-chalcopyrite, silicon-arsenic, silicon-antimony, and "cerusite." There are a host of others, of course, but these are the principal ones being used on army and navy sets to-day. Some of the minerals are best known under their trade names—as "Perikon," "Pyron," "Radiocite," etc.

As aforementioned, radio investigators have devised many different forms of detectors, most of which *rectify* the high frequency antenna currents, i. e., change them from alternating to direct or uni-directional impulses by some kind of valve action, thus rendering them capable of operating the telephones at an audible frequency. This rectification process is shown graphically in Fig. 1 at A, B and C. Curve A shows several damped wave trains such as received on a radio antenna; curve B delineates these wave trains rectified by the detector so that the current is allowed to pass only in one direction, while the graph C denotes the form of current pulse passing thru the telephones, where the rectified current is smoothed out by the inductance of the telephone receiver windings. Thus it is seen that what the operator hears in his head 'phones is not the high frequency aerial oscillations, but a rectified pulsatory current having a (group) frequency corresponding to the frequency of the current charging the condensers at the transmitting station. If it employs a 500 cycle alternator, then the operator at the receiving station hears a 500-cycle note in his head 'phones, etc.

As to the hook-ups used with the mineral detector, let us glance at Fig. 1. This shows how a *non-battery* mineral, such as galena, iron pyrites or silicon, is connected up in a simple tuned circuit comprising aerial, tuning coil T C, and ground. A high resistance pair of 'phones is invariably used in such systems, connected either across the detector or the fixt condenser as the dotted lines indicate. Fig. 2 illustrates how the *battery-using* mineral is commonly hooked up with a potentiometer having several thousand ohms. A better form of circuit and now used in the Signal Corps outfits is shown at Fig. 3-A. Here the current passes around thru the secondary of the loose coupler. Three volts (2 dry cells) is usually the potential applied across the terminals of the potentiometer. The potentiometer slider (or switch) is adjusted until the maximum strength of signal is heard in the 'phones. Also the direction of the current thru the mineral is important and it is well to provide a pole-changing switch in the battery circuit so that the current can be reversed thru the detector. The mineral is usually connected to the negative battery line.

The *Perikon Detector* was developed by Dr. G. W. Pickard. This detector consists of two crystals—copper pyrites (Cu Fe S_2) and zincite (zinc oxid ZnO), held in firm contact against each other in the manner shown. The copper pyrite crystal is mounted in a cup mounted on a spring-actuated rod provided with a suitable knob, by which it can be swung in any direction. Zincite crystals are mounted in a large cup containing several pockets, the mounting of both of the minerals being effected with a low fusing solder, Wood's metal or Hugonium alloy. The action of the Perikon detector is supposed to be based on the rectifying principle previously described; that is, it will pass current in one direction but not in the other, and thus the incoming radio frequency oscillating (alternating) currents in the aerial are rectified and caused to give a sound in the high resistance 'phones connected to the detector. This detector is invariably used with a battery of about two cells and the potential applied regulated by a potentiometer. When using a battery the polarity of the current must be such that the positive wire is connected to the copper pyrite crystal.

Diagram Fig. 3 shows the simplified connections for a "Radioson" (sealed-point) electrolytic detector, the 'phones serving as

(*Continued on page* 64)

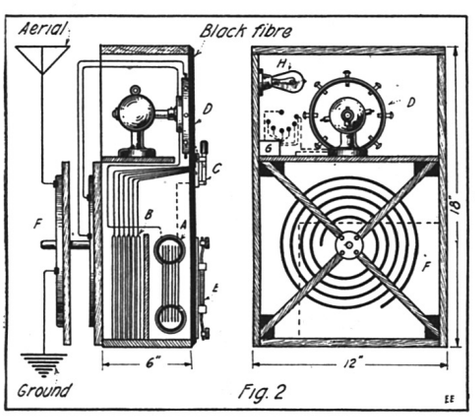
Design for a Panel Transmitting Set

By James R. Hopkins

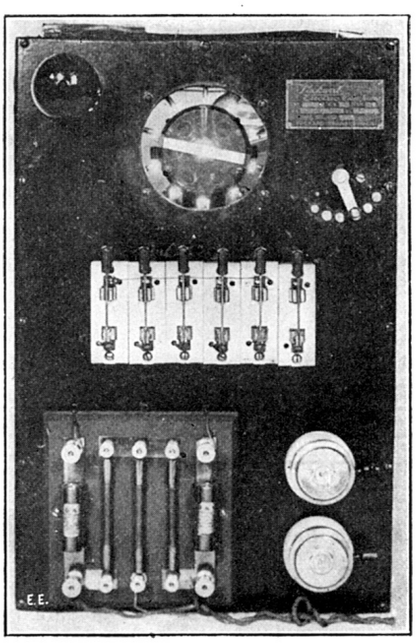
Did you ever consider that compactness and efficiency in wireless means success? Many amateur wireless operators place their transmitting apparatus a good distance apart so that each instrument may show off to its best advantage, and by doing so they little consider the unnecessary length of the connecting leads, which offer great resistance and very often a lack of resonance in the circuit, thus producing unsatisfactory results.

For the benefit of those who are looking for success I shall endeavor to describe a Rotary Gap, panel type, transmitting set, which is not only very efficient but offers a good appearance. A set of this type makes possible very short connecting leads, which are absolutely necessary in an efficient short wave radio transmitter.

The arrangement of the apparatus should be clearly seen by the accompanying drawings. Compartment A contains the transformer embedded in sealing compound, B is the adjustable condenser, consisting of twelve 8x10 inch glass plates, coated with tinfoil 6x8 inches; these are connected in sections of two plates each and controlled by switches C, mounted on the panel. Compartment D contains a rotary gap of the ring type; the ring and rotary arm should be made of Bakelite. E is a protective device to carry off kick-backs and may be of the carbon rod or of the condenser type, as the builder prefers.



Side and Rear Views of Panel Type Transmitter, Showing Arrangement of Oscillation Transformer, Rotary Spark Gap, Etc.



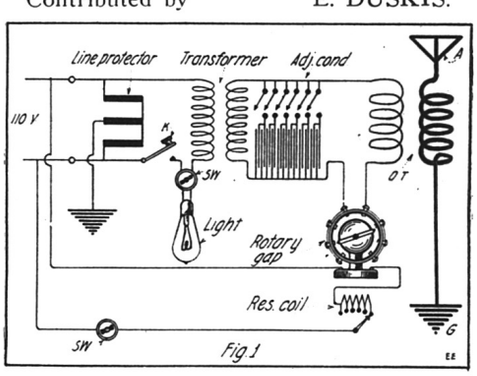
How the Front of Panel Type Radio Transmitter Looks. Rotary Gap at Top; Condenser Switches at Center; Kick-back Preventer at Bottom.

The oscillation transformer F is of the pancake type. A resistance coil G is placed in series with the rotary gap motor to vary its speed, and the light H may be connected in series with the transformer for short distance work.

I am not able to give any fixt dimensions, as transformers, motors, etc., vary considerably in size; with the ½ K.W. set I am using, the cabinet is 12 inches long, 6 inches wide, and 18 inches high, built of ½ inch birch, with the exception of the panel, which is of black fiber ¼ inch thick, this being firmly screwed to the case to prevent warping.

The hook-up is given in Fig. 1 and the general scheme of arrangement is shown in the side and back views in Fig. 2, while the front view (photo) shows the panel on which all control switches are neatly mounted.

If the general idea of construction is carried out, I am sure the builder will be greatly pleased with the results. I used this set with great success for over a year prior to the war.



Complete Wiring Diagram for Panel Radio Transmitter. Note Pilot Lamp in Primary Circuit. Gap Motor Has Speed Controlling Rheostat.

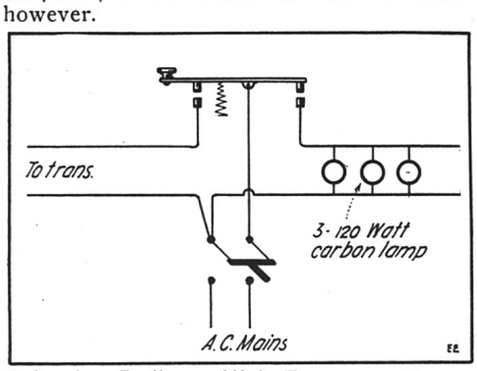
A UNIVERSAL SOLDER.

A very novel scheme for making a solder that beats the ordinary solder is as follows: Mix with a good brand of soldering paste as much granulated bar or wire solder that possibly can be mixed (which is done for the sake of economy) and a solder of excellent qualities will be made. It is useful to the electrician in that wires "up in the ceiling" can be soldered by applying this mixture, and it is then only necessary to apply the heat of a match. Many other ways for its use will suggest themselves to the everyday practical man. In fact, it will save lots of solder from being wasted by dropping to the floor, as is the case when applied by the old method.

Contributed by E. DUSKIS.

TO STOP LIGHTS FLICKERING.

Many radio amateurs who are annoyed, and are annoying others, by drawing too much current from their supply line, might be interested in a way to remedy this. The diagram illustrates this without much description; a few words will not be amiss however.



Balancing Radio or High Frequency Transformer, With Lamps to Prevent Flickering of Lights on Regular Lighting Circuits.

This idea is not recommended for powers exceeding one half kilowatt as the cost of operation is higher. The writer uses this with entire satisfaction on a transformer of 360 watts input; to balance this current consumption, a lamp bank consisting of three 120 watt carbon lamps is used. In the case where a transformer of higher or lower rating is used, the lamp-bank or any other resistance must be made exactly according. It is important to use nothing but silver contacts on back end of key lever, of the same size as those used on transformer circuit; it is well also to have as little vertical play as possible.

Contributed by L. H. REINER.

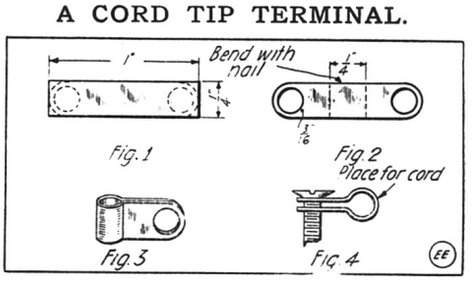
DETECTING 'PHONES WOUND WITH GERMAN SILVER WIRE.

The use of high resistance 'phones for use in wireless telegraphy has led many unscrupulous manufacturers to wind their 'phones with German-silver wire, getting the necessary resistance without the efficiency of the copper wire wound 'phones. This cannot be detected by measuring the resistance and since in many cases a few layers of copper wire are wound on over the German-silver, it is rather difficult to detect these inferior instruments.

However, we can take advantage of the fact that the coefficient of resistance of copper is much greater than that of German-silver. It is only necessary to connect a galvanometer in series with the 'phones and a few cells of dry battery. On closing the circuit note carefully the reading; allow the current to flow for several minutes and if the galvanometer needle gradually drops back you may be sure the windings are of copper wire; but if the needle stays at the same point or nearly so for several minutes, the windings are of German-silver.

Contributed by T. W. BENJAMIN.

A CORD TIP TERMINAL.



It's Always a Mean Job to Properly Connect Cord Tips to Apparatus. Here's a Good Way of Doing It.

Take a piece of springy metal, one inch long and 1/4 of an inch wide. Put a small nail in the middle and bend the strip of metal as shown, and bore a hole in each end to fit a screw. It will be the saving of much time and patience.

Contributed by L. SIMMONDS.

Theory of Tuning, Wave Lengths and Harmonics*

By Prof. F. E. AUSTIN

Instructor of Electrical Engineering, Thayer School of Civil Engineering, Dartmouth College

SO-CALLED *resonance* is of very great importance in the operation of wireless apparatus, and every operator should have a good working knowledge of the theory of resonance and of its practical application. Even the experimenter will work to much greater advantage, with a knowledge of the fundamental law and its careful application, in making and operating tuning coils and similar devices.

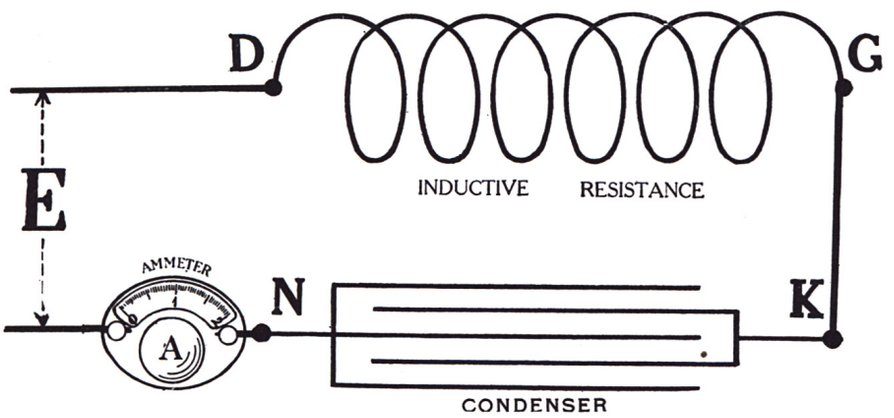


Fig. 1.—The Fundamental Theory of Wireless May be Better Understood by Studying This Elementary Alternating Current Circuit, Comprising an Inductive Resistance and Capacity Connected in Series.

When a coil, consisting of a number of turns of insulated wire is connected in series with a condenser, and an alternating pressure applied to the terminals of the arrangement, as indicated diagramatically in figure 1, the alternating current in the arrangement indicated by an ammeter connected as shown may be exprest by:

$$I = \frac{E}{\sqrt{R^2 + \left(2\pi f L - \frac{1}{2\pi f C}\right)^2}}$$

If a direct current pressure, having the same numerical value as the alternating pressure be applied to the same arrangement, the ammeter will show no indication at all; the condenser, having a very high resistance, really prevents any direct current from passing. Of course, a direct current does exist while the condenser is being charged, but this is so small the ordinary ammeter will seldom indicate this minute momentary current. With an applied alternating pressure, however, the result is very different; since the condenser is very rapidly charged and discharged, the ammeter indicates the presence of the current continuously.

Considering now the different symbols employed in the given equation it may be noted first that the numerator E denotes the applied alternating-pressure, having a frequency denoted by f (f means the number of complete cycles per second). R denotes the resistance of the coil, exprest in ohms, C the capacity of the condenser in *farads,* while L denotes the so-called coefficient of inductance of the coil, exprest in *henrys.* L depends upon the square of the number of turns of wire of which the coil is composed; that is, of two coils of the same general shape, the one having twice as many turns as the other will have four times the inductance.

Also a coil having an iron core will have very much greater inductance than the same or a similar coil without the core. When, as in wireless work, it is desired to employ very high frequencies, coils, having no iron cores are used, since they may be magnetized and demagnetized very quickly and without absorbing an excessive amount of energy. The symbol π denotes the value of 3. 1416.

It is instructive to note that if the condenser be removed from the circuit and a direct-pressure be applied to the terminals of the coil, the direct current may be exprest by $I = \frac{E}{R}$; that is, according to Ohm's law.

Now, by looking at the first equation it is evident that the last equation may be obtained from the first when the numerical value of $2\pi f L$ is made equal to $\frac{1}{2\pi f C}$. When such numerical relationship obtains in any case, then *resonance* is said to exist.

The value of π is, of course, a constant at all times and the value of f is definitely fixt for any given circuit. It is, therefore, apparent that with a given fixt value for $2\pi f L$, a similar numerical value for $\frac{1}{2\pi f C}$ may be found by varying the value of C. The value of C for any condenser depends upon the *number of sheets of* dielectric used in making the condenser, upon the *kind of material* the dielectric consists of, upon the *size* of the dielectric sheets, and upon a numerical *constant* which is dependent upon the kind of units employed in expressing size or area, and thickness.

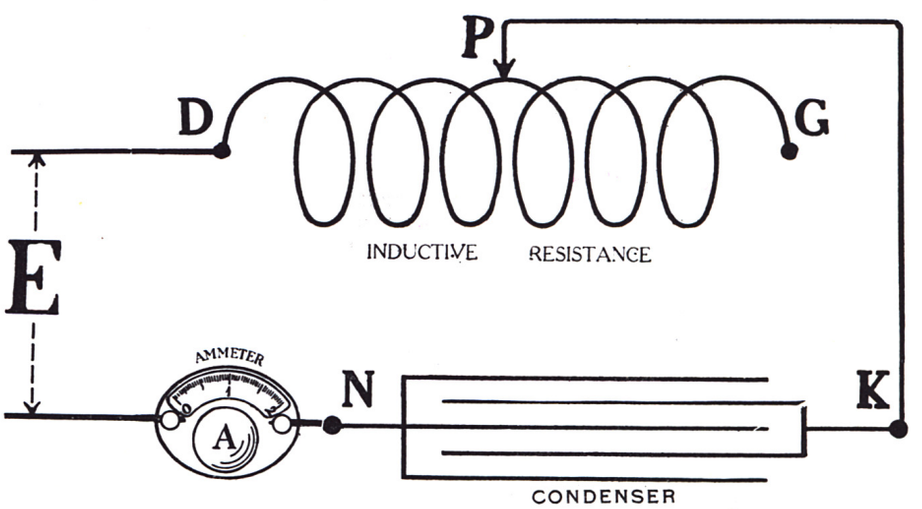


Fig. 2.—This Alternating Current Circuit Should Be Carefully Studied by All Radio Students, as It Contains Similar Elements to Radio Circuits, i. e., a Variable Inductive Resistance and a Capacity or Condenser.

The capacity of ordinary condensers made up of sheets of dielectric and metal plates, may be exprest by:

$$C = .000,000,000.224 \frac{A n}{t} \; k \; farads.$$

In the equation A denotes the area of each dielectric sheet in square inches, n the number of sheets used. k the so-called specific inductive capacity of the dielectric, and t the thickness of each dielectric sheet in thousandths of an inch; that is, in *mils.*

The coefficient of inductance of a coil having an iron core may be approximately exprest by:

$$L = \frac{4\pi n^2 A}{b \times 10^9} \; henrys.$$

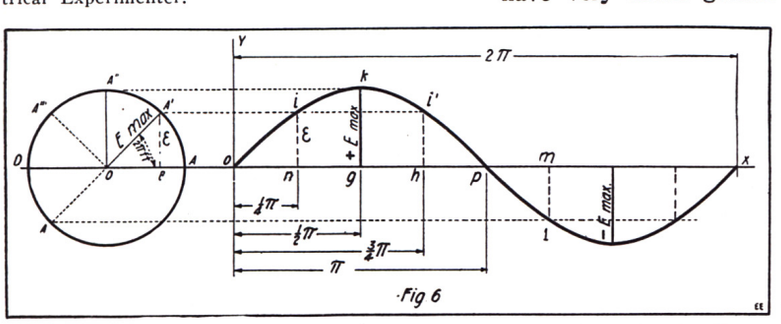


Diagram Representing the Generation of the "Sine Curve"—the Form of the Average Alternating Current Wave.

* This article especially prepared for the "Electrical Experimenter."

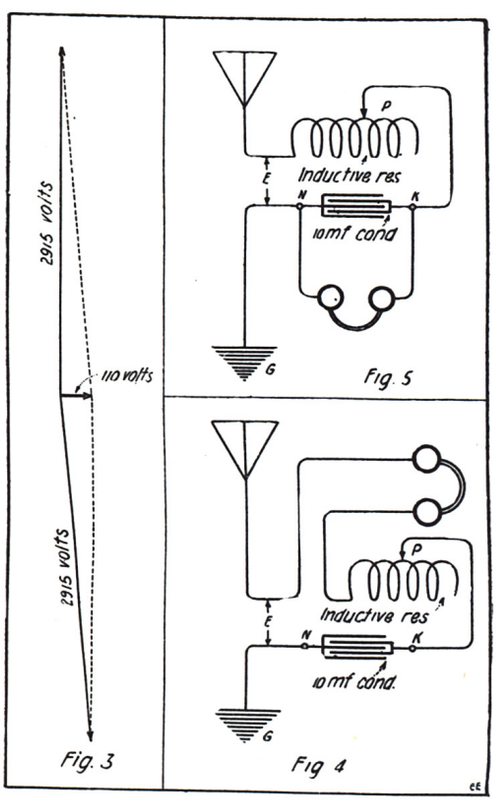
in which π has its usual value, n denotes the *number of turns* of wire wound on the coil, A denotes the area of the hole thru the center *of the coil,* exprest in *square centimeters,* and b denotes the *length* of the coil (not of the wire), exprest in centimeters.

Returning to the consideration of the initial equation, and restating the condition for resonance as when $2\pi f L = \frac{1}{2\pi f C}$ it is evident that the equation may be changed to;

$$2\pi f C = \frac{1}{2\pi f L}.$$

The reason for the latter arrangement of the equation is because it is much easier to construct a coil to produce a variable inductance than it is to construct a condenser to give a variable capacity.

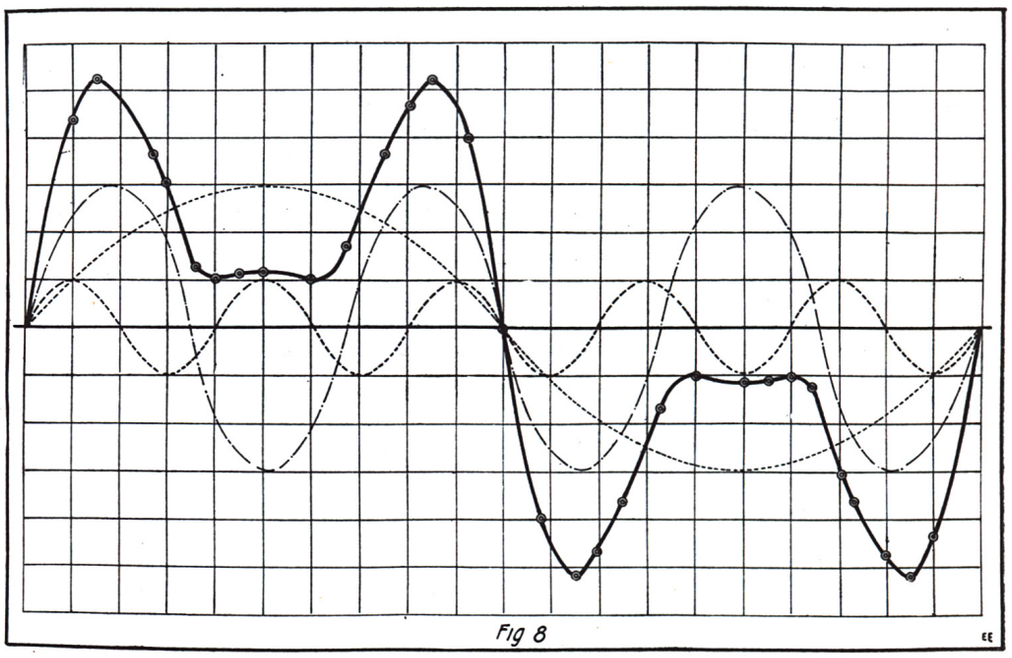
Considering the last equation, it is evident that if $2\pi f C$ has any given numerical value, with a definite value of frequency (value of f) then some value may be given L, so that the numerical value of $\frac{1}{2\pi f L}$ shall be equal to the numerical value of $2\pi f C$.



Diagrams Showing Effect of Resonance on E. M. F.'s in Different Parts of A. C. Circuit; Also Simple Radio Circuits Used for Comparative Study.

If a condenser having a definite fixt value of capacity C be connected, as shown in figure 2, in series with a coil so arranged as to allow a different number of turns of winding to be introduced into the circuit as desired, then the physical apparatus will fulfill all of the variable conditions possible, with a fixt frequency f.

Looking at the proposition from a slightly different standpoint, suppose the condenser in figure 2, has an unchangeable value of capacity and suppose the contact point P is so arranged as to include in the circuit more and more turns of the coil as the contact moves toward the right. With any definite value of the frequency of the applied pressure, some position of the contact P will be found such that the indication of the ammeter will be a *maximum.* If the contact be moved toward the left from the position giving a maximum, the ammeter indication *decreases,* and if the contact be moved toward the right from this position, the ammeter indication also *decreases.*



Every True Alternating Current, of Any Shape Whatever, Is Made Up of a Certain Number of Simple Sine Curves Added Together. The Heavy Line Represents the "Resultant" Wave Form, Produced by the Addition of the Three Sine Waves Indicated in Light Lines. These Component Curves are Called the "Harmonics."

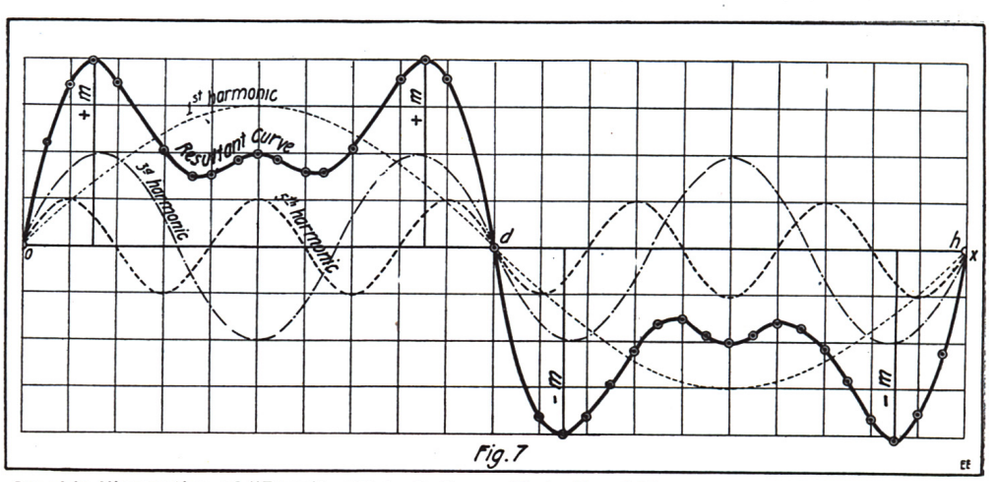
To make the matter clearer and more concrete, it will be well to assign definite and practical numerical values to the various symbols in the last equation. Let us suppose the frequency f of the applied alternating pressure is 60 cycles per second; then $2\pi f$ is equal to very nearly 377. Suppose further that the capacity C of the fixt condenser is 10 microfarads or $\frac{1}{100{,}000}$ (.00001 *farad*). One million microfarads are equal to one farad. According to this assumption $2\pi f C$ becomes equal to $377 \times \frac{1}{100{,}000}$. Next suppose that $\frac{1}{2\pi f C} = .00377$. Then, since $2\pi f = 377$, $L = \frac{1}{377 \times .00377} = 0.703$ *henry.*

If, therefore, a condenser having a capacity of $\frac{1}{100{,}000}$ farad is connected in series with a coil having an inductance of 0.703 henry, then resonance obtains in the circuit for a frequency of 60 cycles, and the current in the circuit is a maximum. The numerical value of the maximum current depends upon the numerical value in volts of the applied pressure, and upon the resistance in ohms of the coil or part of the coil that is connected in the circuit.

Suppose the pressure is 110 volts and the ohmic resistance of the wire on the coil is 10 ohms, then under the conditions of resonance mentioned, the current will be $110 \div 10 = 11$ amperes.

A very striking and important phenomenon should be noted at this point, namely, the numerical value of the drop in pressure between the terminals of the coil and also between the terminals of the condenser. The drop in pressure between the terminals of a condenser when resonance obtains in a circuit is exprest by $I\left(\frac{1}{2\pi f C}\right)$ which in the case under discussion is equal to; $11 \times \frac{1}{.00377} = 2915$ volts (approximately). The pressure drop between the terminals of the coil may be stated by; $I\sqrt{R^2 + (2\pi f L)^2}$ which is numerically equal to $11\sqrt{10^2 + (377)^2} = 2915$ volts; very nearly. This condition of affairs seems a bit uncanny. It does not look exactly logical that the pressure between the

(*Continued on page* 59)



Graphic Illustration of "Resultant" A. C. Curve Made Up of Three Simple Sine Curves, or the 1st, 3rd, and 5th "Harmonics."

Building an Electric Piano Player

By CHARLES HORTON, Consulting Engineer

CONTRARY to the general opinion among amateur mechanics the automatic piano, aside from the instrument proper, is a comparatively simple thing. There have been developed commercially two general types of player actions, the *electric* and the *pneumatic*. The operation of the latter is as follows:—There is provided a pair of bellows arranged to be worked by the feet of the player which supply the air to run the motor for moving the record and for striking the notes. These bellows do not, as would naturally be supposed, compress air to operate the mechanism but rarefy it; in other words, the device operates by suction. The use of suction instead of compression is had because of the advantage that since with suction the air is drawn in thru the holes in the record, there is a strong pressure on the record causing it to adhere closely to the tracker bar and thus preventing the striking of accidental notes. Thus it is seen that the foot bellows draws air from the reservoir provided, and this suction causes the driving mechanism to turn the record feeding roll. Whenever a hole in the record comes over the tracker bar, air is permitted to pass in thru the corresponding tube and this air relieves the suction in one of the key-striking bellows, allowing it to spring open and strike the proper note.

So much for the pneumatic type of action. The electrical mechanism is similar to the action of the pneumatic except that contacts take the place of the holes in the tracker bar and magnets take the place of the bellows while a motor drive is provided to turn the record roll.

At first glance the construction of an *electric action* would appear to be somewhat beyond the ability of the Amateur, but a detailed examination of the apparatus herein described will show that there is nothing at all difficult in the work; but owing to the large number of similar parts the work requires a good supply of patience and persistence. However, the result is well worth the effort, particularly when it is understood that the costs of a commercial attachment runs into the hundreds of dollars.

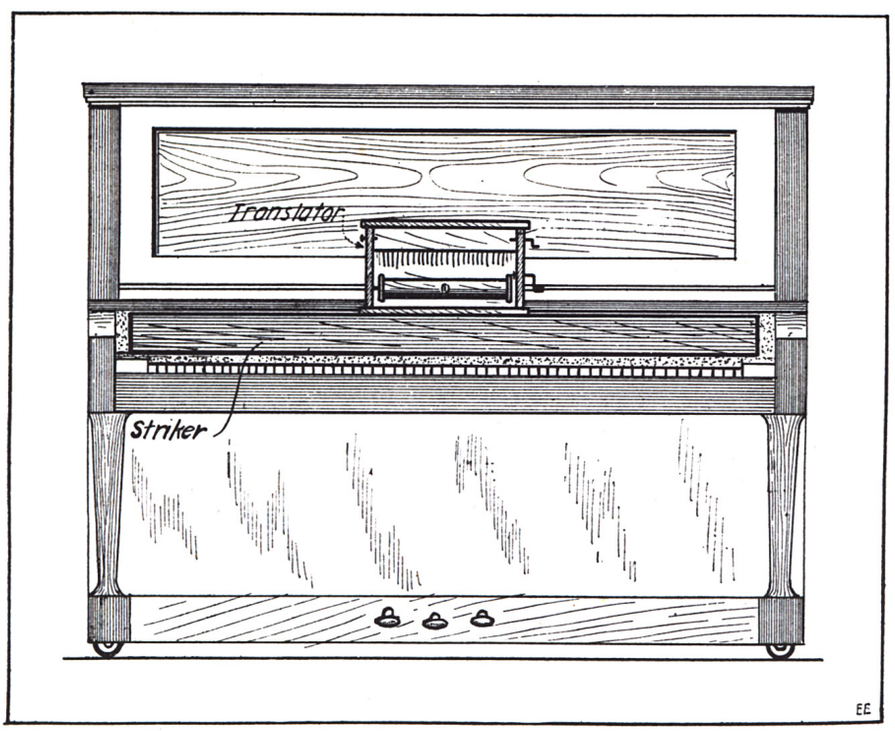


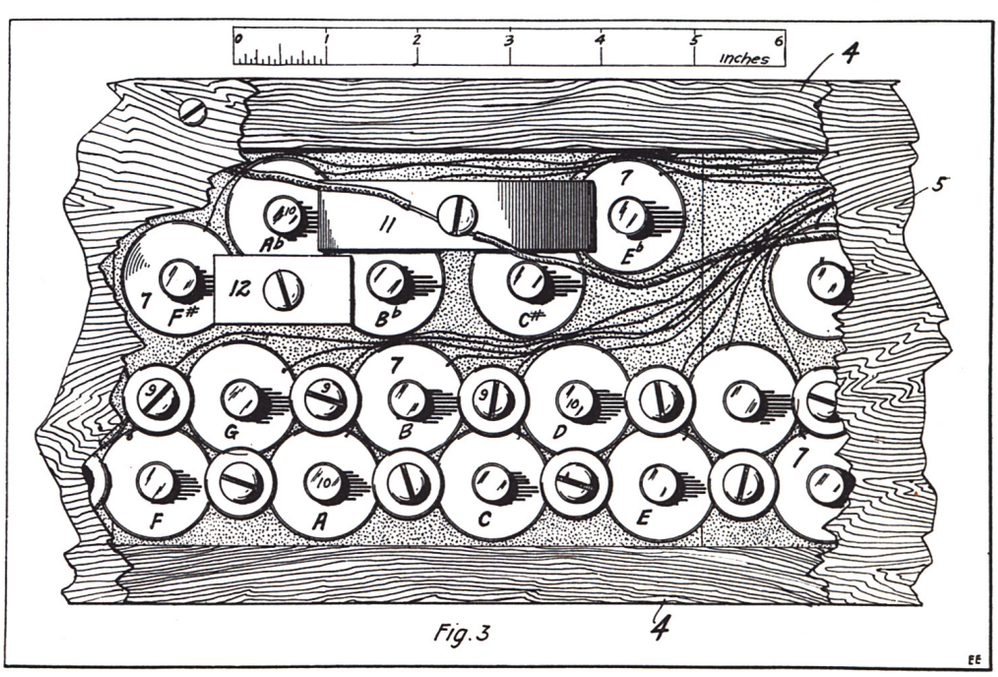
Fig. 1. Front View of Standard Piano Fitted with Electric Player, Including Music Roll Translator. Standard Player Piano Rolls Are Used. Current 110 Volts or Battery.

The arrangement here described is similar to the commercial electric mechanism but is very much simplified. The record is driven by a small hand-crank (or may be driven by a small electric motor) by means of which, also, the tempo is controlled while the ordinary pedals of the piano are used in the regular manner. The loudness may, if desired, be controlled by a simple rheostat and when one has had some practise in the manipulation of the apparatus, one can get very nearly perfect expression from this simple instrument.

The apparatus takes the form of an oblong cabinet which is adjusted just above the keys of the piano and is held in position by its own weight. The record reading mechanism (translator) is mounted on top of the same as is clearly shown in Fig. 1. There is provided one magnet for each key of the piano and one corresponding contact on the tracker bar.

The apparatus plays the standard paper music rolls which range in price from ten cents to several dollars and permits the reproduction of all the standard music at a very low cost.

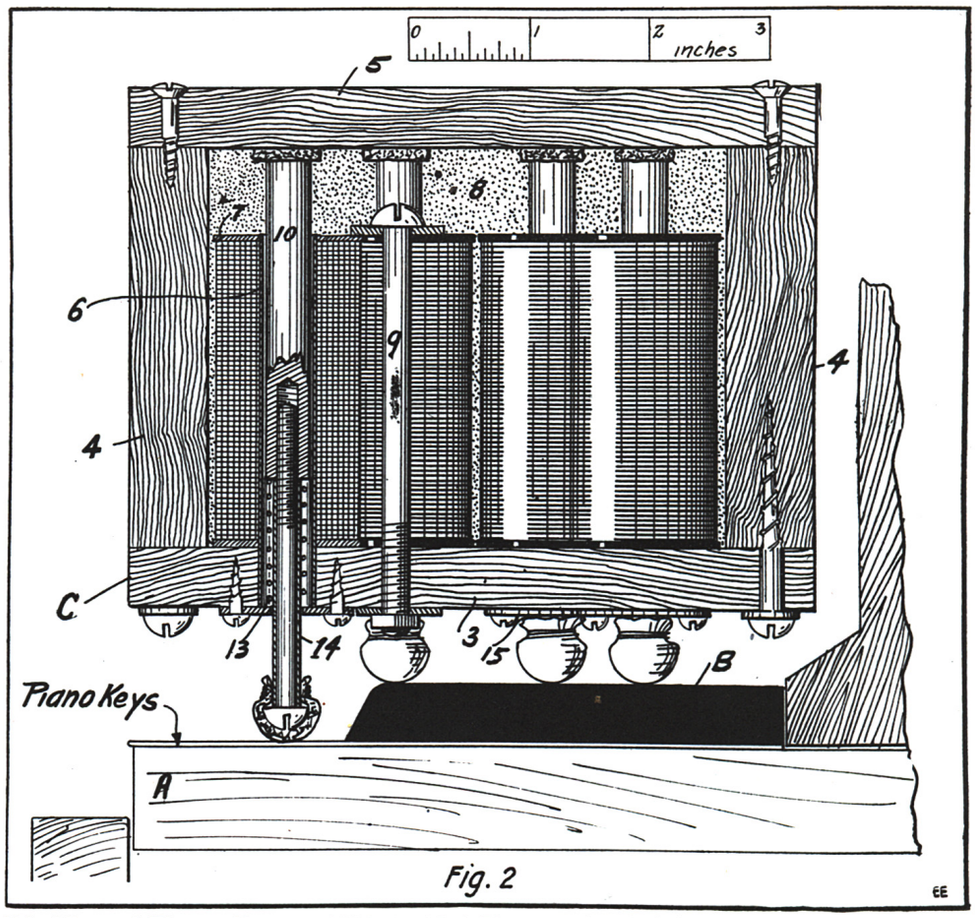
The construction of the simplified apparatus will now be explained in detail. Referring to Fig. 2 in connection with the following description the arrangement of



Top View of Group of Twelve Electro-Magnets for Playing Keys of One Octave on Piano.

parts may be made clear. This view is a transverse section of the box containing the striker magnets. *A* represents one of the white piano keys, *B* one of the black keys and *C* the supporting board for the magnets. All the striking magnets are mounted on this board which is screwed to the two side strips 4, in order to prevent it bending under the weight. A detachable top 5 is screwed to these two side pieces, which arrangement allows easy inspection of the striking mechanism. Reference to Fig. 3, in connection with Fig. 2, will serve to make clear the arrangement of the magnets, etc. This illustration is a view looking down on the top of the striker box, and delineates part of the top board broken out to show the arrangement of the magnets. There are, of course, seven white keys and five black ones to each octave of the piano; consequently twelve magnets have to be provided for each octave. One magnet is mounted above the center of each key and in order to find room for so many magnets they have to be arranged in the manner shown, *i. e.*, in four rows.

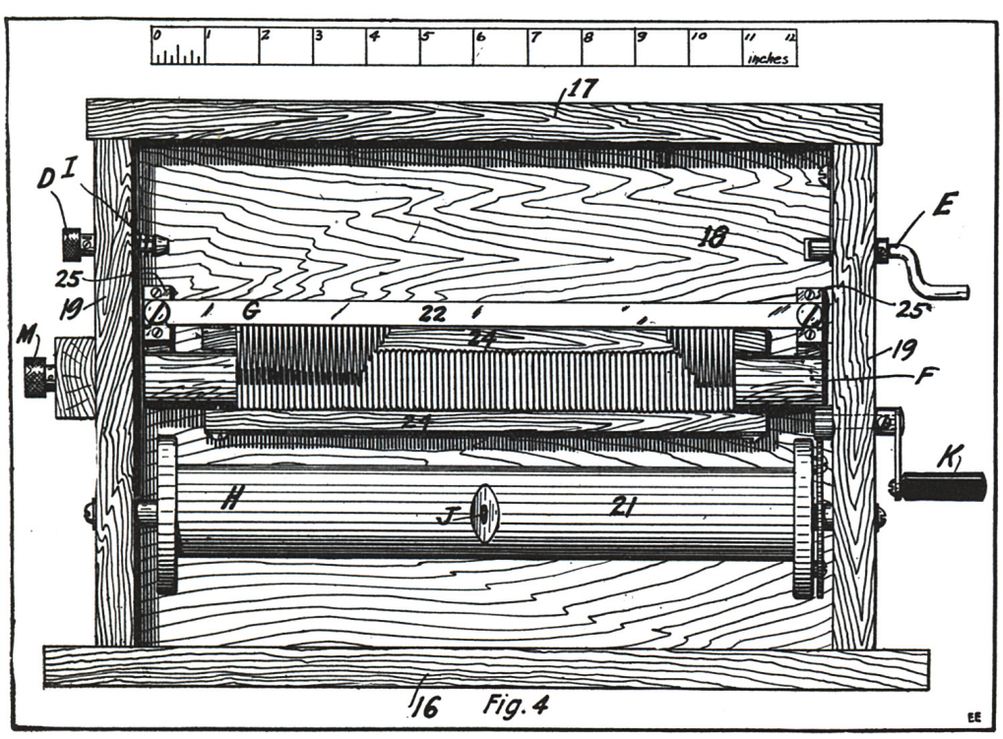
Each magnet consists as shown of a brass or aluminum tube, detail 6 (this tube must not be iron) on each end of which is forced an iron washer 7. Brass is best for the tube 6, so that the iron washers may be soldered on. The end near the lower washer 7 extends downward, thus forming a projection which enters a hole in the supporting board *C*. The bobbin formed by the tube and the two washers is wound full of number 18 double cotton covered magnet wire, thus forming a solenoid for actuating the keys. The magnets are secured to the supporting board 3 by means of several ¼" iron stove bolts 9, which also, together with the iron washers, complete the magnetic circuits. Within the tube 6 is arranged to slide freely the iron core 10, and screwed into the bottom end of this iron core is a long brass screw with a round head which is covered with chamois to form a hammer as illustrated in Fig. 2. When the circuit containing any one of the magnets is completed, current flows around the bobbin 6-7, and causes the iron core 10 to quickly move downward, thus striking the corresponding piano key. As will be seen by examination of the detail drawings, the entire bank of magnets is divided into seven groups, each group consisting of seven white-key strikers and five black-key strikers. This arrangement is advisable in order to make the assembling easy and also permits the correct placing of the strikers above the keys without extremely accurate layout work.



Side View of Electro-Magnets With Padded Plungers for Striking Black and White Piano Keys.

In Fig. 4 is shown a front view of the record carrying mechanism, usually called the *translator*. This is to be mounted on top of the striker box and contains a free moving stud *D*, and a free crank-shaft *E*, between which the record roll is caught; a tracker bar *F* having on it one contact for each magnet; a comb *G* having one finger for each contact; and a receiving roller *H* for receiving the paper roll as it unwinds. The record roll is placed between *D* and *E* by pulling *D* to the left against the spring and placing the right-hand end of the roll against the screw-driver-like crank *E*. The comb *G* is then removed from under the heads of its retaining screws by slipping it upwards and the end of the record led over the tracker bar *F* and fastened to the receiving roller *H*, by slipping the ring in the end of the record over the little hook *J*. The comb is then replaced with its fingers bearing on the paper record and the receiving roller rotated slowly by turning the crank *K*. Now when the holes in the paper record come under the fingers a contact will be made and the proper magnets will receive current and strike the proper keys. When the record is finished the comb is removed and the record re-rolled by means of the crank *E* (or by motor, if one is used for playing the piano). The tracker bar and the comb are mounted on an independent board, the construction of which is shown clearly in Detail No. 26. This board is arranged to slide sidewise in the main translator box for this purpose. The paper has a tendency to work over one way or the other on the tracker bar and thus tend to get the holes out of alignment with the comb fingers, causing imperfect reproduction, in which case it is necessary either to shift the record or the tracker bar. In this mechanism we shift the tracker board 24. This motion is usually very little and is tended to with the left hand on the knob *M*. Reference to Fig. 5, at the right, will make clear how turning the knob one way will slide the tracker bar and comb to one side, and turning in the other direction to the other side.

(To be concluded)



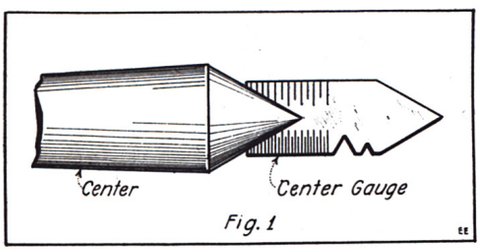
Front View of "Translator" Which Controls Circuits of All Key Magnets, the Contacts Being Opened and Closed Thru the Perforations of the Standard Music Roll.

Experimental Mechanics

By SAMUEL COHEN

LESSON III.

BEFORE the novice can begin to handle the lathe it is essential for him to become familiar with some of the odds and ends of the parts of the machine. To begin with there are several cutting tools which he should understand very thoroly, as each one



Showing How the "Center Gage" Is Used in Testing a Lathe Center While Being Turned or Checking Up for Trueness After Considerable Wear.

of them is for a definite purpose. The amateur must also know how to sharpen these tools, in order that they may give the best results. All of these problems will be taken up in order.

The first thing that experimental machinists should see to is that the lathe centers are running true. These are made of tool steel; the one in the revolving spindle is usually soft, because it turns with the work which is to be machined. The one at the tail stock is hardened. This is done because the article to be machined revolves on this center and causes constant wear. A good plan is to test occasionally the trueness of these centers. In Fig. 1, a center is shown being tested for angular slope by means of a *center gage*. It is very important that the end slopes to a 60-degree angle. In order to machine any round stock article between centers of a lathe, it is necessary to determine at first the centers on both sides of the article, then to drill and countersink each end so that it may revolve on the centers with ease.

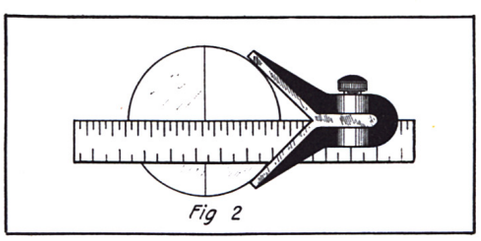
There are several ways of centering a round piece, and two of the simplest and best methods will be considered. The first one is to employ a *combination square,* as shown in Fig. 2, and carefully scratching across the face of the work with either a pencil or scriber two diameters at right angles. The point of intersection of these two diameters will be the center of the cylinder. A center punch is set on the point of intersection and driven into the metal until a good indentation is made. This method will be found to be very useful and helpful, as it is the simplest and quickest. The only additional tool required is the *combination square,* and one can be bought for a nominal sum.

The second method of centering is to use the lathe itself. Fig. 3 shows how this is done. The article in question, A, is firmly secured in the *live* chuck of the headstock and a drill chuck C, with a proper arbor, is secured to the spindle of the tail stock D. A special centering drill B is secured in the drill chuck. By setting the main chuck holding the article and carefully bringing the centering drill to the face of the article, then gradually forcing the drill into the metal surface, it will automatically find the center and drill the hole and at the same time countersink it. Care should be taken to see that the drill does not advance too rapidly into the metal, as it might catch and break the drill. Sufficient oil should be poured on the drill when in operation. Another point to remember is to see that the article in question does not turn very fast.

These centering drills are very handy, and the amateur should not be without one, as they will be required very frequently. There are several sizes on the market and they can be bought in any reliable store carrying machinery supplies.

Accidents will happen now and then and a center drill may break, part of the broken drill remaining in the shaft. This broken part should be immediately removed. Sometimes the experimenter may be able to work the broken part out with a chisel, but occasionally it sticks so hard it cannot be removed. When this occurs the broken part of the drill left in the shaft must be annealed; the only way to anneal it is to anneal the end of the shaft. To do this heat the end slowly and evenly over a fire to a dark red, and then place it in lime or ashes and let it remain until it is entirely cooled off. It is then ready to be worked and the broken part can easily be removed.

It is very important to note that every hole be properly countersunk if it is to be used between centers. The beginner will



Using the Center Line Attachment of a "Combination Square" for Scribing Center Lines on End of Shaft or Rod, in Order to Find the Exact Center Before Boring Lathe Center Hole.

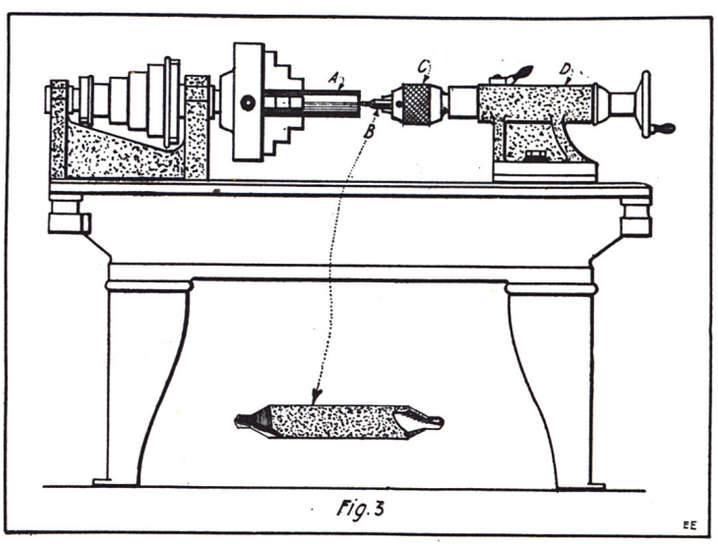
find it very advantageous to begin with the right method of countersinking and thus avoid breaking down or quickly wearing away his *dead* center point. A very poor and improper way of countersinking is shown in Fig. 4. The center bears the point on the article without any bearing surface support, and as soon as the article turns and a load applied to the surface of the article by the cutting tool, the point would not be strong enough and thus breaks or *burns* off. This, of course, results in a loss of time in re-sharpening or re-grinding the center. The proper method of countersinking a hole for lathe work is delineated by Fig. 5. In this case it will be noticed that the countersunk portion bears firmly on the slope surface of the center and *not on the point.*

This method of countersinking is accomplished by first drilling a small hole in the part where the centering is desired and then countersinking it with a countersink having a 60-degree cutting edge. In other words, the countersunk portion should have the identical slope as the slope of the center of the lathe, which is also 60 degrees. It is well to remember that whenever you desire to turn a piece of work by means of the centers, see to it that its internal centers are clean, as otherwise the work will not run true or may damage the lathe centers.

If the amateur does not use a universal chuck on the *live* spindle for holding the work, a tool called the lathe *dog* will be found useful in connection with the face plate. The first photograph of the second installment shows how it is used, while Fig. 6 shows a common form of the lathe dog. The work is secured inside of the ring of the dog and firmly tightened in the same by means of the lock screw. The centers of the machined article are placed on the lathe centers while the bent portion of the dog is placed into any of the slots of the face plate. This will cause the work to turn when the live spindle is rotated by applying the driving power. There are several sizes of dogs on the market, and it is advised that at least four sizes should be on hand. The 1-, 1½-, 2½- and 3½-inch type will be found most satisfactory for the work which the novice will encounter at the beginning. The lathe dog cannot be used at all times, especially when a short piece of metal is desired to be machined. In this case a chuck is very helpful, and the amateur should not be without one. A 4-inch 4-jaw universal chuck with two sets of jaws will be found very useful.

The accuracy of the work will depend upon how accurate the chuck turns, and for this reason it is strongly advised that the beginner should not attempt to set the chuck on the live spindle himself, as a great deal of skill is required to do such a job. It is recommended to have a good machinist place the chuck on, if the chuck has not been directly purchased from the lathe manufacturers, who usually do this kind of work for the purchaser. The amateur has only to bring the original face plate with the chuck and its face plate to a machinist and have him fit it on. He has to properly thread the chuck face plate with the right thread, which he gages from the original face plate.

In using a lathe for cutting purposes, special tools are used for each particular



Showing Detail and Manner of Using "Centering Drill" in Tail-Stock Chuck to Bore Center Support Hole in Stock to be Machined.

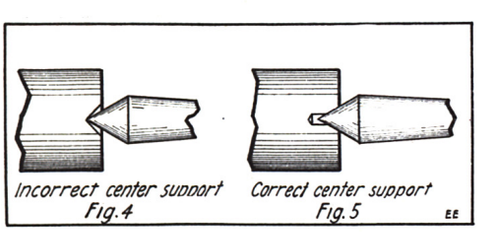
cutting operation, and it is advised right here that the young machinist should become very familiar with the use of every lathe tool. There are twelve lathe tools which have been selected for the amateur as the most practical for every-day use, each one of which will be shown in the following succeeding drawings. The names of each will also be given. The arrows indicate the direction of the feed of the tool.

The first of these tools is shown in Fig. 7, which is the *left-hand side tool,* and it is used whenever the left side of a shoulder is machined, and for nothing else. To cut down or machine a right-hand shoulder, a *right-hand side tool* is employed, as shown in Fig. 8. At times it will be found that the same job can be done with another tool called a *right-hand bent tool,* illustrated in Fig. 9. To turn down or reduce the diameter of a shaft, a right- or *left-hand diamond point tool* is used, as shown in Figs. 10 and 11. These two tools will be found very useful, but if they are not used right they will damage the work. It is necessary that the point be kept perpendicular to the cutting surface as much as possible. To smooth out the surface of a piece of work in the lathe use the *round nose tool,* indicated in Fig. 12. At times it is necessary to cut off a piece at a certain place or to make a slot; in this case the *cutting-off* tool is used, and this is shown in Fig. 13.

There are three tools for cutting threads on a lathe; the first *threading tool* is shown in Fig. 14, and this is used whenever the surface is straight. If, however, a thread is to be cut on a shoulder, the *bent threading tool* is employed, as in Fig .15. This is used because it permits the cutting of the thread to the end of the shoulder. To cut an inside thread we employ an *inside threading tool,* as in Fig. 16.

Whenever a large stock of material is to be cut at one time the *roughing tool* will be found very useful, and this is shown in Fig. 17. Before starting to use this tool, it is necessary to see that it is adjusted on the tool post to take a pretty heavy cut, or else it will miss the cut on the metal and spoil its edge. To cut an inside hole, or to increase the diameter of a hole, use a *boring tool,* as this is the only use for this tool, and this is shown in Fig. 18. The work in this case is always held in a chuck.

The position of the cutting edge of the tool is of extreme importance and should be carefully noted by the beginner if he desires to machine his work without spoiling it. The proper position of the cutting edge of the tool should be just slightly above the center line of the working centers. About 5 degrees above is found to give best results for practically all work. The position of the tool will also depend upon its clearance and rake and upon the material to be cut. However, a little practise on the part of the amateur will soon enable him to learn the proper height for different kinds of work. Great care should be exercised to see that the cutting edge of the tool does not extend too far from the tool post, especially on a heavy cut, because the nearer the *tool post is to the work the more firmly the tool post will be held* without undue chattering.



This Diagram Shows Clearly the Correct and Incorrect Method of Countersinking Stock to be Supported on a Lathe "Center."

When machining or turning down a piece of cast iron it will be found that if a heavy cut is not made at the beginning that the surface scale of the cast iron, which is mostly sand, will ruin the cutting edge of the tool. It is advisable for this reason to take a heavy cut at the beginning, so as to remove the surface scale.

The effective cutting on a metal will largely depend upon the degree of sharpness of the cutting edge and upon the manner it is ground. The tool should have plenty of clearance, a good rake and a clean cutting edge. The tool should be ground on either an emery or carborundum wheel which is running quite fast. The tool should be kept cool during grinding, and this can be done by immersing the tool into cold water every few seconds during the grinding process. After the tool has been ground on the wheel it is then well to dress up the cutting edge by hand with a small oil or fine carborundum stone. This will improve the wearing qualities of the cutting edge.

It is advised that the novice should become a thoro master of the above facts, as they are the fundamentals to the successful operation of the lathe. If these points are overlooked there is very little hopes of turning out a real good piece of work on the machine.

(*To be continued.*)

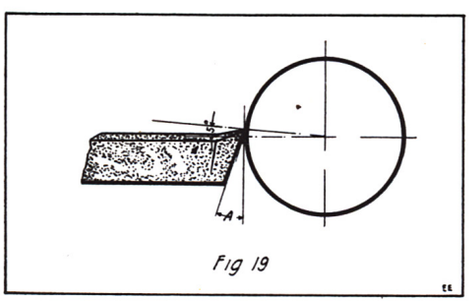
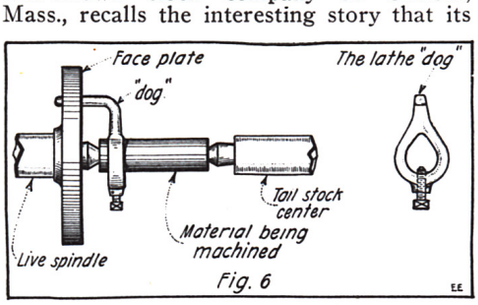


Diagram Showing How the Lathe Tool Should be Set with Respect to the Work Being Machined.

CLOCK NEWS.

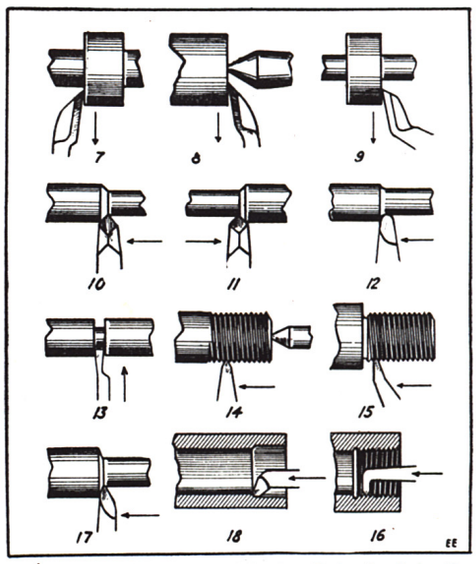
By Thomas Reed.

The recent labor-flurry at the plant of a well-known clock company in Chelsea, Mass., recalls the interesting story that its establishment in that city was due to the unusual accessibility of raw material.



The Lathe "Dog" Is a Handy and, at Times, Indispensible Appliance for Turning Shafts, Spindles, Etc.

In former days Chelsea was one of those placid social units, like Philadelphia, which refuse to be drawn into the hurry of modern life. The unthinking applied to it the derisive phrase "dead as Chelsea"; but the horologists of the period recognized that a population with so much time on its hands was in a position to furnish an abundant supply of that valuable commodity for the use of busier communities, needing only clocks to render it fit for consumption. Much time also was, and is, done at the neighboring State Prison in Charlestown—one Pomeroy alone being credited with an output of more than 40 years of it; but this source of supply was soon found unavailable, owing to the prejudice against prison products.



This Cut Illustrates All the Principal Lathe Tools Which the Amateur Machinist Will Need, in Order to Perform Most Any Kind of Work.

At all events, the local offering proved so copious that the company always had time to burn; and the great Chelsea conflagration of 1907 was at first attributed to its disposing of its surplus stock of minutes and seconds in that way. Such was not the company's practise, however, as a constant market existed for any over-stock with the tin-alarm-clock makers, whose flivvers consume a heavy excess in running fast to offset the periods when they do not run at all.

While a strike in a clock-works is, of course, a natural occurrence, it is seldom that the striking is done by the hands, at least in the plant referred to. The present one resulted from an effort to Hooverize the week by reducing it to a length of 48 hours. Whatever the outcome of the pourparlers, however, it is understood that the company's timepieces will continue to furnish the old measure of 168 hours between bath and bath.

ELECTROLYTIC TREATMENT OF LEAD POISONING.

Dr. L. G. Witherspoon, in *Southwestern Medicine,* gives his recent experience at a large industrial plant in the electrolytic treatment of lead poisoning. The method used is that of Dr. H. L. Jones of St. Bartholomew's Hospital, London, as perfected by Sir Thomas Oliver on the suggestion of T. M. Clague of that city.

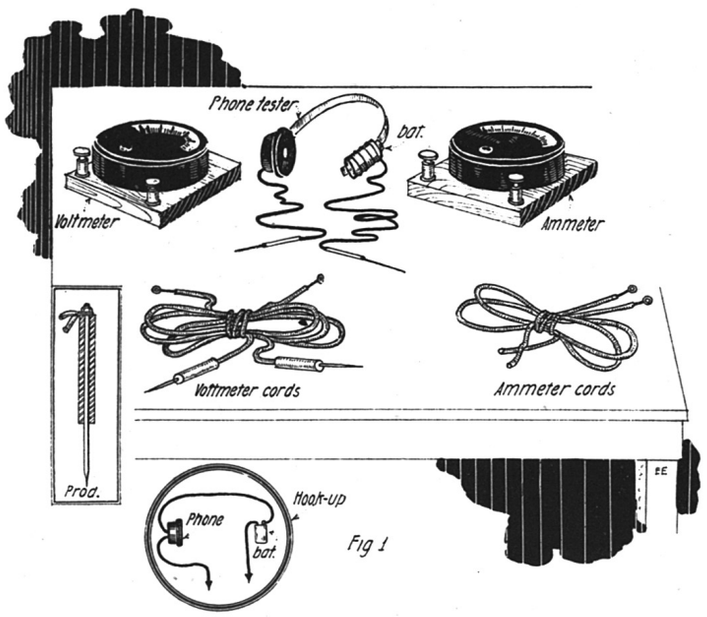
Instead of immersing the patient in an electric bath, the outside bipolar system is resorted to. The patient sits on an insulated chair with the feet in a basin holding salt water, 15 grains to the pint, the hands in a similar basin, the positive wire going to the foot basin and the negative to the hand basin. A current of 16 volts passes for from 20 to 40 minutes daily or every second or third day, depending on the severity of the case. Ordinary cases require at least 25 days. For prophylaxis one weekly treatment usually suffices. Severe cases with wrist drop or cerebral symptoms may demand treatment for 60 days or even longer.

The latest style of electric railroad crossing signal imitates the waving of a lantern by hand exactly. The advantage of this lies in the fact that a moving light will attract more attention than a stationary signal.

"Shooting" Electrical Troubles on Automobiles

By THOMAS W. BENJAMIN

AS a rule the motorist just begins to realize that the electrical equipment of his car is subject to failure when it refuses to ignite or crank the engine for the first time. Then the garageman is given a hurry call and, more often than not, a call-down, when the bill arrives a little later.



The Apparatus Required to Test the Electrical Circuits of Your Automobile are Few and Need Cost But a Few Dollars. Where Hundreds are Invested It Will Amply Repay You to Make These Tests Periodically or at Least Know How to Make Them When Something Goes Wrong.

Despite its seeming complicity the electrical apparatus will respond to a little care and can be kept in the pink of condition if the little faults that develop are taken care of before they become large enough to cause any great trouble. For instance, it is not noticeable when one side of the battery becomes *grounded,* and the car may run in this condition for months, but, Ah! BUT—when the *other side goes to ground* it often means a new storage battery and perhaps an overhauling of the generator.

The instruments required to test the electrical equipment on the car from time to time is not costly, while it constitutes the best form of insurance one can buy. A voltmeter with a range of 0-10 volts, or 0-15 if a twelve volt system is used, and an ammeter reading 0-30 amperes, are required. Reliable small meters can be purchased for $5.00 to $8.00 each.

Test cords are required for the above meters. For the voltmeter cords, use single lamp cord, two 6 ft. lengths being cut. Fit one end of each cord with a lug to make connections to the meter, the other end having a *prod* made from a 6-inch length of ⅛ inch round iron rod. A suggestion for making the prods is given in Fig. 1. The cords for the ammeter are but two feet long and are made of double lamp cord, fitting one pair of terminals with lugs as in the previous case and the other ends with heavy spring test clips. Those with flat jaws are the best for the purpose.

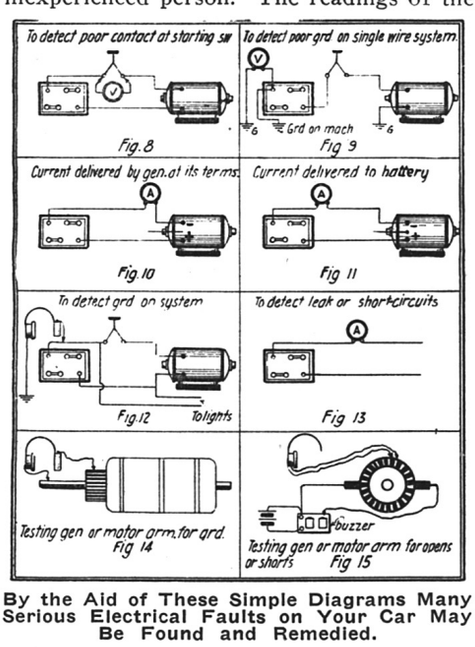
A hydrometer is necessary, a dollar bill buys a good one—the writer has seen them on sale for a quarter, but purchase one fitted with a syringe—it's much cleaner and easier to handle.

Altho not absolutely necessary a simple device for testing out circuits will be found handy. The simplest form comprising a 75-ohm watch-case telephone receiver fitted to a head-band and a small two-cell flashlight battery taped to the other side of the headband, (Fig. 1). One post of the battery being connected to one terminal of the telephone, a set of 4-foot cords, fitted with small prods, are connected to the remaining terminals on 'phone and battery. This completes the apparatus required. The various instruments are illustrated in Fig. 1.

We can now test any electrical equipment and locate the tiny faults that may sometime tie the car up on the road. And should trouble develop we can easily locate it. The prudent auto driver or owner will always test the electrical equipment before starting on long tours, and even before making fairly long ones.

Motor Fails to Crank Engine—Cranks Slow or Lights Are Dim.

Turn the engine over by hand to see that the bearings are not stuck. Take gravity reading on all the storage cells; this is a good indication of their condition if they have not been tampered with by some inexperienced person. The readings of the cells should not vary more than twenty points and should be over 1.200. If below this the battery is discharged and should be charged at once. If the cells vary greatly in the reading locate the trouble. It may be due to a short-circuited cell, broken separator or high sediment.



By the Aid of These Simple Diagrams Many Serious Electrical Faults on Your Car May Be Found and Remedied.

If the gravity is over 1.200 in all cells the battery should crank the engine and the trouble is elsewhere.

Take a voltmeter reading on the battery as shown in Fig. 2, the battery should read 6.5 volts or a little higher, with a 3 cell battery; a 6 cell battery should be twice this. Should the voltage be below this figure and the gravity 1.200 it indicates that too much acid has been put into the cell.

With the voltmeter still across the battery, switch on the lights as in Fig. 3. There should be a very small voltage drop, if it is excessive it indicates a *short-circuit* on the wires that is draining the battery. Test each circuit independently to locate the circuit on which the *short* exists. By tracing the wiring the trouble can be removed.

Now have someone close the starter switch, if no trouble is located on the light circuits as in Fig. 4. The voltage may drop as low as 5.2 volts with a three cell battery and no trouble will be found. Should the voltage drop below this figure, the cells are low and need charging. When using the starter for testing, the switch should be kept closed only long enough to take the readings for the drain on the battery is excessive.

A test should now be made of each individual cell as in Fig. 5. Closing the starter switch after connection is made to each cell in turn. Should one cell or cells be lower than the other or others, it indicates discharge due to short-circuit, lost active material or defective separators. Should a cell give a reverse current this may be due to the above causes or low electrolyte. A charge should be given the battery from some outside source or by running the engine if the generator is in operative condition.

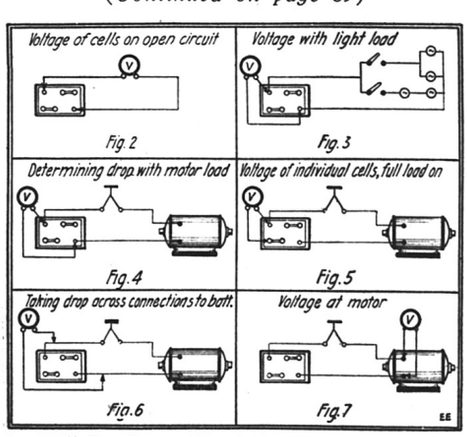
Should the cells test O. K., attach the voltmeter leads to the cables from the battery as shown in Fig. 6. If a drop of voltage is noticed over that from the battery terminals, it indicates corroded or broken connections. Remove the cable from the battery and scrape off the corrosion, after cleaning thoroly, rub the parts well with vaseline and reassemble, making sure that the connections are tight. Another test with the voltmeter should show no drop.

These tests practically eliminate the trouble from the battery and attention should be turned to the other parts of the system.

The voltmeter should be connected across the terminals of the motor as in Fig. 7 and the starter switch closed for an instant. If there is a decided drop in voltage at the motor terminals over that at the battery terminals, with the starter on, the trouble lies in the wiring or the starter switch.

A test of the starter switch can be made as in Fig. 8, by shunting the voltmeter across it and closing the switch. A reading on the meter indicates a defective switch, usually

(*Continued on page* 69)



As Will Be Seen All of the Test Connections Necessary for Locating Trouble In Your Battery or Dynamo Are Extremely Simple.

A Tight Squeeze for Uncle George

By THOMAS REED

I CAME near going on the stage once. Not to act, you understand—not as bad as that—but simply to show stage-managers a few things about their business. In the fresh springtime of my career, I never hesitated to butt, with a few pertinent suggestions, into any ancient art or science I ran across; and having, at the time of this tale, just made the acquaintance of the drama, as a means of livelihood, which had been plugging along quite a spell on scanty resources, I deigned to give even that lowly calling a little attention.

The occasion was my Uncle George's taking me to the theater for the first time. In those days, people approved of the theater as heartily as they do of opium-dens now,—that is to say, scarcely at all or less; but "Unk" had a theory that it was beneficial to make the Devil's acquaintance young, so he insisted (as much as he had to) on my going along.

We had to watch our step carefully, because a previous expedition of ours under his theory (I think it was a horse-race) had caused unmistakable demur in the family. It made father almost impetuous. He said that while a pesky bachelor (Uncle George was such) might poison his own soul in any lothesome way he saw fit, it meant a hell-sentence for him to lure innocent Youth into the clutches of the Evil One; and he went on to describe, for "Unk's" special benefit, the warmth of that particular hell reserved for middle-aged reprobates convicted of luring. This was before the invention of thermit and oxy-acetylene, and the only fuel that Theology possest, to get up steam for the sinners with, was "fire and brimstone." With the modern inflammables, father's imagination of hell would have made him such an extra hazard around the house as to vitiate our fire-insurance policy; but he did pretty well with even the old-fashioned chemicals. He did so well, anyhow, that Uncle George, when he called to take me to the matinee, thought it prudent to employ camouflage, and carried conspicuously two smelt-poles and a can of bait, which he left in a vacant lot after they had created the desired atmosphere of innocence.

The "theater" that agitated the old folks so, meant plays like "Uncle Tom's Cabin," and "Ten Nights in a Bar-Room," that dript, like a shirt in the wringer, with morality and sadness. As even these dismal sketches were supposed irresistibly to skid the virtuous from the strait and narrow path, a stupefied horror overspread the community when, along in the eighties, came the first "show" that actually aimed to be merry. "Good-night!" said the community; "so there was something worse, after all!"

This new show was "The Black Crook." Today, we should call it "Spectacle" and "Extravaganza," and let it go at that; but to the elders, it was a moral catastrophe, without any special classification. They objected to it practically in toto, as the fellow says. They objected to the "story of the play," or plot, because it was a downright lie—not even "founded on fact," which at least you could say for Eliza's trip on the ice. And what did you think of the witches, and fairies, and men drest up like animals? Didn't that give you false impressions of life? I should say so. Then, look at the dancers, and card-trick players, and actors that made believe intoxicated—all the forms of iniquity you ever heard of, and then some! But the most outrageous feature of all, the one mentioned with heavily bated breath, was the *tights*. Would you believe it? Women—or beings in female form—actually came on the stage wearing nothing but—sort of stockings, you know, on their—their—well, what they wear stockings on!

It was only after "The Black Crook" had departed (it had quite a long run before all the sinners were accommodated) that my spiritual health was regarded as beyond danger.

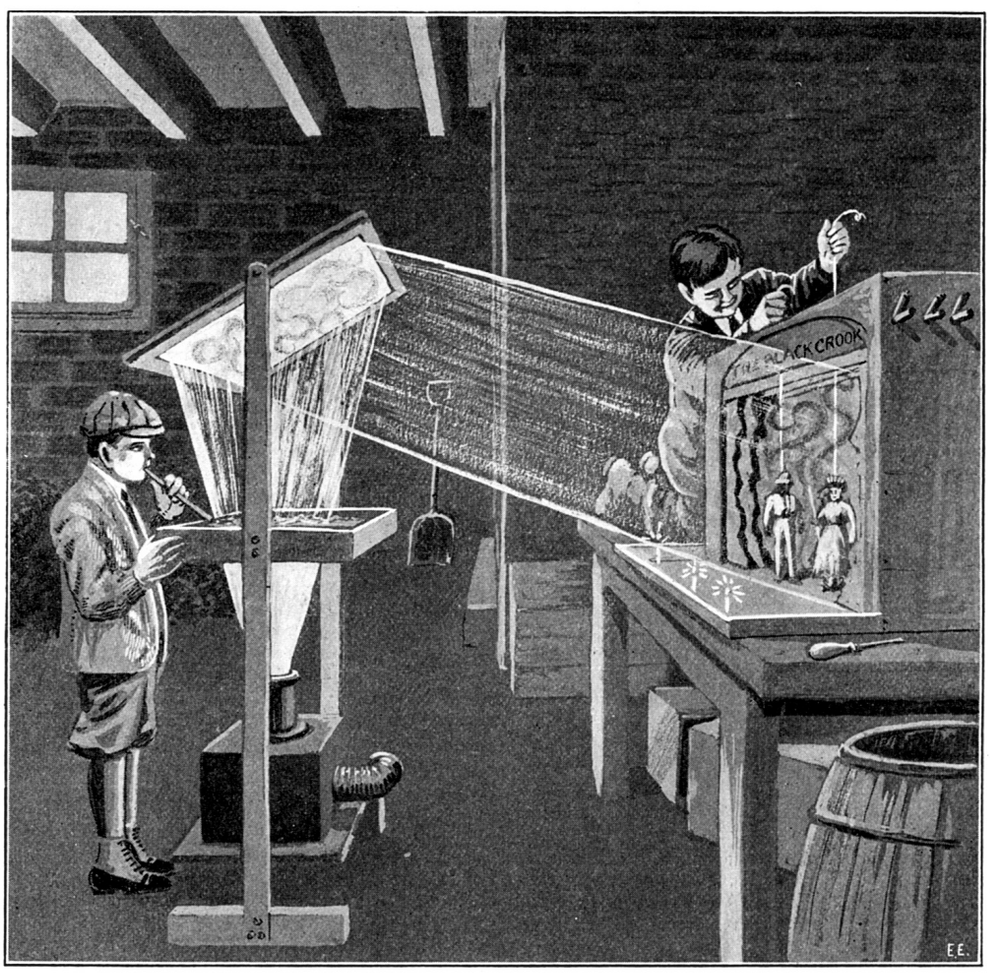
But alas! (you get me?) it happened to be that very show which Uncle George took me to see.

It surely was a busy afternoon for Little Nephew, with his Inventive Mind. The celebrated ladies in stockings were all that fancy painted—and more, for they'd done some painting on their own account. These, being the work of so competent an inventor as the Devil, were clearly beyond my powers of improvement, but the mechanical devices promptly met with my usual constructive criticism. Our being seated in the front row helped some. Uncle George said he had to sit there, on account of being very near-sighted. Not having heard of his infirmity before, I felt sorry for him, and told him so; after which, my conscience allowed me to reap the benefit of his misfortune. Several inventions occurred to me, so close together that they almost overlapt. I mentioned them to Uncle George, but the Amazons were marching, and he seemed preoccupied. Evidently the show as it stood was good enough for him.

The chief of these inventions was inspired by a beautiful blue light, studded with stars, which invaded the stage at certain intense moments. Something told me it was produced by a glass plate shoved in front of the calcium light; the display being heralded by the magnified image of the chipt edge of the plate, followed by a flock of elephant-tracks, due to prints of the operator's fingers, stained by honest toil.

At the first sight of this spectacle the invention referred to burst upon me with that sort of Faradic shock familiar to inventors, particularly young ones. By the time it came again my apparatus was completed (mentally) to the last detail. By the third view I was storming the theatrical profession with it, and making lucrative contracts right and left; and the royalties were just about to pour in, when—the show was over, and Uncle George was suggest-

(*Continued on page* 67)



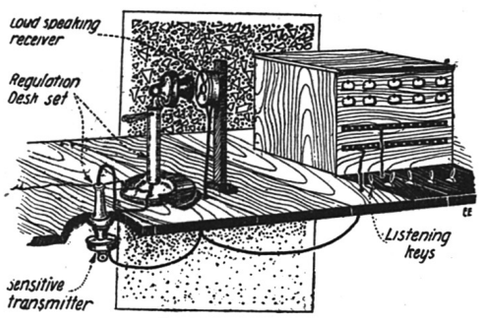
". . . . . My Magic Lantern Being Lighted, I Scattered a Few Drops of the Various Colored Oils on the Water in My Tank, Blew Gently Across the Surface Thru a Straw, and Was Delighted to See the Colored Discs Stretch Out, Mingle in Bands Like a Roman Sash or Form Gorgeous Designs Varying from Moment to Moment. But When Father Found It Out ! x ? x . . . . ."

This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.
The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded For the best idea submitted a prize of $3.00 is awarded; for the second best idea a $2.00 prize, and for the third best prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $3.00

MAKING BATTERY 'PHONE SERVE AS "EXTENSION."

The subscriber who may desire one or more "extensions" must needs have the extra equipment installed by the 'phone



A Clever Scheme for Transferring an Incoming Telephone Call to an Intercommunicating Battery 'Phone, Without the Expense of Installing the Usual Extension Instruments.

company and must rent the added apparatus by the year or month, as the case may be. It is a comparatively easy matter, in a plant where private inter-communicating battery telephones are already installed or are about to be, to make the local 'phones serve as the "extensions."

For this purpose we need a very sensitive transmitter and this is recessed into a table or the top of the local telephone switch-board so that the mouthpiece stands flush with the table surface. A loud speaking receiver, properly connected with the sensitive transmitter, is mounted on a standard firmly attached to the top of the table, at such a height that the mouthpiece of the regulation desk 'phone set, when brought close up to it, is concentric with the diafram of the receiver. The arrangement is shown by the accompanying illustration. The regulation switch-board plug jack is used to connect the sensitive transmitter and receiver with the various extensions thru the medium of the switch-board. A block of wood, with a semicircular indent takes the base of the telephone set and insures that it stands always squarely in front of the lour speaking receiver.

Ordinarily, when not in use, the telephone transmitter rests on its hook in the orthodox manner. In establishing connections, between the regular 'phone and any one of the extensions, the operators plugs into the proper extension on the intercommunicating system, places the desk set squarely in front of the loud speaking receiver, and inverts the telephone receiver over the sensitive transmitter as shown, when communication is established with remarkable clearness. It is advantageous, but not essential, to have a regulation switch-board operator's headset and breast transmitter in circuit with the loud speaking apparatus so that the operator can listen in and correct errors.

Contributed by E. F. HALLOCK.

SECOND PRIZE, $2.00

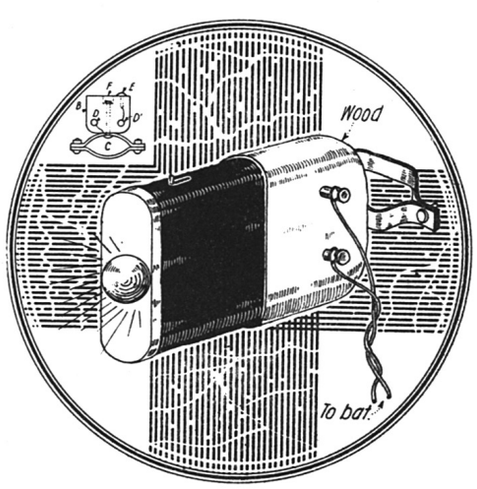
AN INEXPENSIVE BICYCLE LIGHT.

Use an old pocket flashlight, size 1 x 2¾ x 3½ inches which may have neither battery nor bulb. First cut the lower part of the case off, as here shown, leaving a smooth edge. Then from a piece of wood cut a block B so that it will just slip into the open end of the flashlight case. Next secure a clamp from an old bicycle bell shown at C. Bore a ¼" hole from F to C and put a small machine screw thru and countersink the nut in the other end of the block at F. Then take two ordinary battery screws and put thru the block at D D. E, a round head brass screw is put in the end of the block and connected to

AMATEUR ELECTRICIANS! ATTENTION!!

Did you read the prize contest article entitled "Utilizing Burnt-out Lamp Bulbs," which appeared in the April number of this journal? If not, procure a copy to-day. Here is your chance to make some money. Prizes are offered for the best ideas—"What to do with burnt-out lamp bulbs," and prizes will be awarded as follows: First prize, $3.00; second prize, $2.00 and third prize, one year's subscription to the ELECTRICAL EXPERIMENTER. Get busy, boys, and watch for the June issue.

bolt D^1 by a copper wire, while bolt D is connected to the clamp and bolt C. Slip the case over the block and tack on both sides or glue it to the block. Remove the cap



A Nifty Electric Bicycle Head-light is Easily Constructed From an Old Pocket Flashlight in the Manner Illustrated.

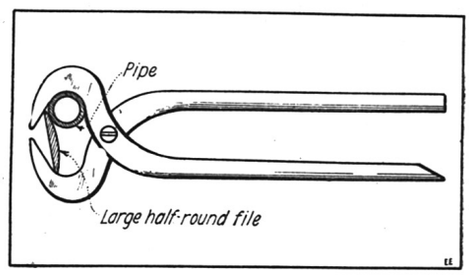
holding the lens and you will see that when push button is drawn back, the metal strip touches the screw E and connects it with the metal case of the flashlight, also that the end of the bulb will touch the end of the bolt and thus make the circuit thru the bulb from the two binding posts D and D^1. Next buy a 2.5 volt flashlight bulb which can be obtained from any electrical store. The lamp case may then be given a coat of black enamel. The two dry cells (they do not have to be new as it will burn on partly used ones) required may be fastened to the stem between the front fork and the handle bar of the bicycle with a strap wrapt around them and the stem and allowed to rest on the bar running down to the crank. They should be connected to the lamp on the handle bar with flexible wires so that it will not break when turning corners.

Contributed by DONALD WILSON.

THIRD PRIZE, $1.00

SUBSTITUTE FOR PIPE WRENCH.

I herewith show a drawing of a substitute pipe wrench which I have found very useful, and which I believe will be of



Ever Want to Grip a Round Rod or Pipe Without a Wrench Handy? Use This Stunt —It Works!

use to others. The drawing is self-explanatory. A file and a pair of pincers serve the trick.

Contributed by ROBERT D. FOWLER.

EFFICIENCY OF PRODUCTION OF X-RAYS.

The energy given out in the form of X-rays by a Coolidge tube has been determined by means of a bolometer, the values lying between 20 joules and 125 joules per ampere-second for potentials between 28 kv. and 54 kv. The energy supplied to the X-ray tube has been measured by its heating effect. The ratio between the X-ray energy and the energy supplied to the tube, or the efficiency of production of the X-rays which has been found for these potentials, varies between 0.58 and 1.87×10^{-3}. The X-ray energy is found to be nearly proportional to the cube of the potential across the tube. A comparison of these results with those obtained by others on the total ionization produced by X-rays indicates that only a fraction of the energy of the X-rays is transformed into the energy of the ions produced on total absorption in air.

Under this heading we publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

TO RENDER WATER SURFACE PHOSPHORESCENT.

1. Wet a lump of loaf sugar with phosphorized ether, and throw into a basin of water; the surface of the water will become luminous, and glow beautifully in the dark. By gently blowing upon it, phosphorescent undulations will be formed, which will illuminate the air above the fluid for a considerable space. In winter the water must be blood warm.

2. *To melt a coin in a nut schell.*—Mix three parts of dried niter, one of sulfur, and one of fine dry sawdust and press into a walnut shell, also inclose within the shell a piece of silver or copper, then fill the shell with more powder and set fire to it. The metal will soon be melted while the shell will be merely blackened.

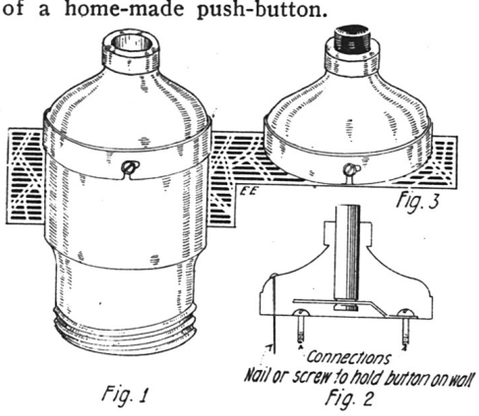
3. *The alchemists' dyes.*—Dissolve indigo in diluted sulfuric acid, and add to it an equal quantity of solution of carbonate of potash. If a piece of white cloth be dipt in the mixture, it will be changed to blue; yellow cloth in the same mixture will be changed to green; red to purple; and blue litmus paper to red.

4. *Two solids make a liquid.*—Rub together in a mortar equal quantities of crystals of Glaubers salts and nitrat of ammonia, and the two will slowly become a liquid.

Contributed by EUGENE McGOWAN.

A HOME-MADE PUSH-BUTTON.

Below is a description and illustration of a home-made push-button.



Here's a Nifty Brass Push Button Made from the Shell of a Discarded Lamp Socket.

The top part of an old electric lamp socket is used for the case, as shown in Fig. 1, and the assembled button is shown in Figs. 2 and 3, which explain themselves.

Contributed by ROBERT WILLIG.

COPPER PLATING.

To copper plate a small steel object proceed in this way: Put ½ teaspoonful of sodium bisulfate in 1/5 glass of water. Now add ¼ teaspoonful of azurite. Heat gently to dissolve the substances. Dip the article that is to be plated into the solution and leave for about one-half minute, and dry on a cloth.

Test to Determine the Freshness of an Egg. Put 2 teaspoons of common table salt into a pint of water. A fresh egg placed in this solution will barely float. The greater tendency of an egg to float on the surface the older it is. This is due to the fact that as an egg decomposes it becomes lighter.

Contributed by S. WATSON MUGHR.

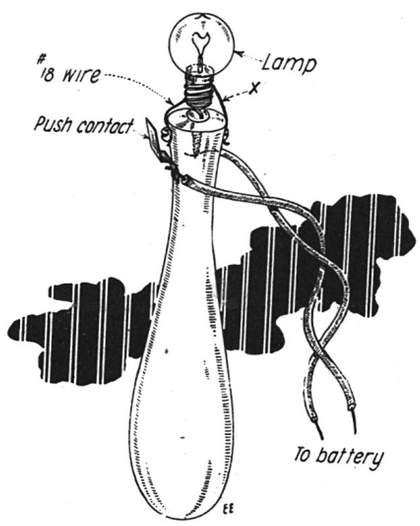
MACHINE OIL.

I submit herewith a good formula for light machine oil. I have never found this oil to gum. Mix 2 oz. sweet or olive oil with 1½ oz. kerosene or coal oil. Then add 12 drops oil of citronella.

Contributed by ROBT. S. ROYER.

A SIMPLE TROUBLE LAMP.

I describe below the plan of a very simple trouble lamp, which I have constructed.



A Wooden File Handle, a Battery Lamp, and Some Wire—You Then Have a Handy Trouble Lamp. A Push Button Can Be Added if Desired.

As you will see by looking at the sketch, the bulb is connected to a round-head screw, which makes contact with the wire which runs into a hole in the handle. The socket for the bulb is made by winding wire around its base, and tacking each end to the handle. The push contact is made from a short piece of thin brass.—Contributed by ALTON H. GOUD.

SYMPATHETIC INKS.

(1) *Rub Out Ink.*—I have named this ink "Rub Out" Ink because it can be rubbed out more easily than it is written with on paper. Take common starch and dissolve it in water and then add some iodine. Shake well before using and write as with regular ink. When dry, it has a purple color and can be erased by simply passing a clean cloth lightly over the paper and leaves no trace on the paper.

(2) A dilute solution of sulfuric acid when heat is supplied, produces fine black characters. Use H_2SO_4 (1) part to H_2O (20) parts.

(3) Combine (1) and (2) and you have the "disappearing reappearing" ink. Use in this way. First write on paper with the mixture of (1) and (2). Then rub out. The writing is not to be seen any more but you can immediately cause it to appear by slightly heating the paper.

(4) If you have not any sulfuric acid at hand to make (2) with, use lemon juice or acetic acid, or citric acid or any harmless acid.

(5) A dilute solution of chlorid of copper used for writing is invisible until the paper is heated, when the letters are seen of a beautiful yellow, disappearing with the heat which develops them.

(6) Weak solutions of nitrat of silver and gold chlorid when exposed to the sun become dark brown and purple respectively.

(7) Potassium ferrocyanid, one part, is dissolved in distilled water, twenty-five parts. When dry lay over the writing a blotter moistened with a dilute solution of ferric chlorid (tincture of iron will answer).

(8) Solutions of cobalt chlorid or the nitro-chlorid yield tracings which become green or blue when heated and disappear again as the paper cools.

(9) Boil some gall-nuts in aqua-fortis and to the infusion add some gum arabic and a little sulfuric acid. However plain the ink may be at first, it will entirely disappear from the paper in a few days.

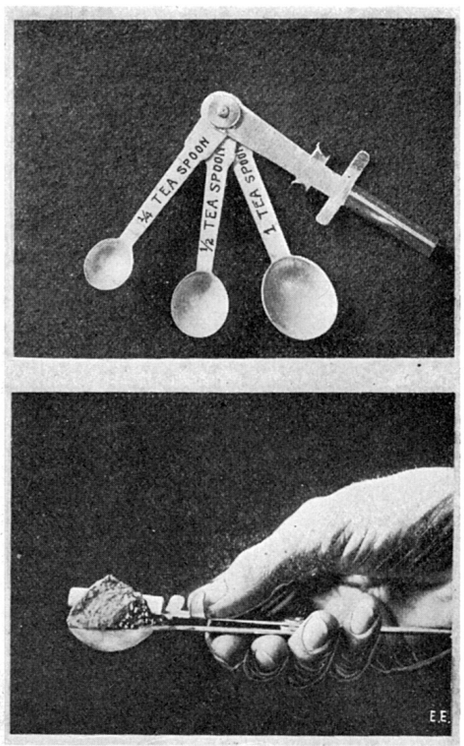
Contributed by DAVID GOODMAN.

EXPERIMENTERS!!!

Don't forget to write up that little "wrinkle." It may win a prize. What we desire are good practical formulas — something you personally have tried out. Maybe it's a new lacquer, a good insulating varnish, a way to bake impregnated electrical coils, etc., etc. If you desire the manuscript returned don't forget to enclose sufficient postage.

A SELF-LEVELING MEASURING SPOON.

A set of measuring spoons with a self-leveling attachment is a recently patented invention which reduces to simplest form exact measurements while using the fewest possible utensils.



A New Measuring Spoon Which Saves Much Time and Many Poor Mixtures. It Always Levels Off the Spoon Even and Is Graduated as Indicated.

The set consists of three spoons from one-fourth to a teaspoon, all riveted to a cleverly contrived bar so that the unused spoons form a handle, while the thumb easily pushes the bar across the spoonful of material, thus securing without using another article—usually a knife—the level spoonful now specified in culinary recipes and other formulæ.

Contributed by MISS H. L. PLACE.

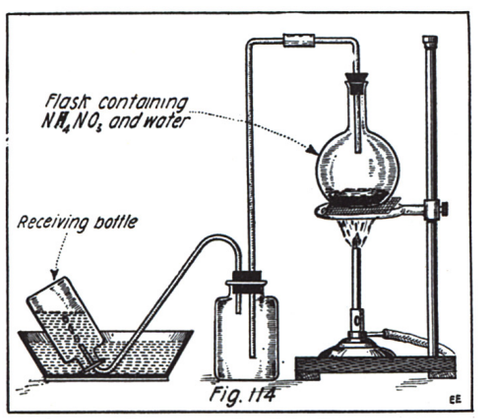
Experimental Chemistry

By ALBERT W. WILSDON

Twenty-Fourth Lesson

Nitrogen Monoxid.

THIS gas, which is also known by the names *nitrous oxid* and *laughing gas,* was discovered by Priestley in 1772. Preparation:—The usual method of preparing this gas is by heating ammonium



Set-up of Apparatus Used in Preparation of Nitrogen Monoxid from Ammonium Nitrat.

nitrat and collecting the dissociated gas over water. This relation is shown by the following equation:

$$NH_4NO_3 = N_2O + 2H_2O$$

Properties:—1. This is a colorless gas, producing a faint peculiar odor, and sweet taste.

2. It produces anesthesia.

3. It is a supporter of combustion. It supports the combustion of many substances as actively as does oxygen.

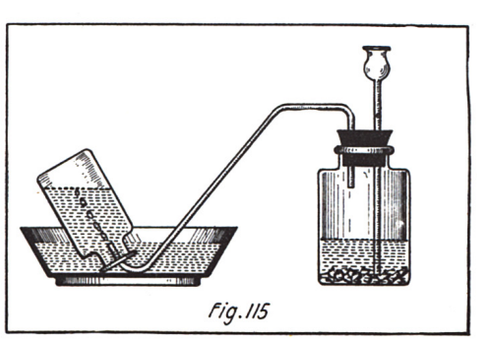
4. When mixed with hydrogen it is explosive when ignited.

$$Na_2O + H_2 = N_2 + H_2O$$

5. It has been liquefied under ordinary atmospheric pressure, requiring —88 deg. It may be liquefied at 0 deg. by a pressure of 30 atmospheres.

As a liquid it is colorless and very mobile, boiling under ordinary pressure at —89.8 deg.

Uses:—This gas (Nitrous oxid) is extensively used by dentists in extracting teeth, where a short anesthetic effect is desired. It is obvious that for this purpose the gas must be perfectly pure. The greatest safeguard to obtain the pure gas is to employ pure ammonium nitrat, the chief impurity of which is ammonium chlorid. Ammonium chlorid if present would occasion the presence of chlorin in the gas. For the preparation of the gas for anesthetic purposes, it is past thru three wash-bottles, one of which contains ferrous sulfate solution which removes the other secondary oxides of nitrogen formed thru secondary decomposition; one of sodium hydroxid solution to remove the chlorin; and lastly one of pure water.



Apparatus Used for the Preparation of Nitrogen Dioxid from Nitric Acid and Copper.

When mixt with air or oxygen the gas produces a condition of partial insensibilty in which the patient becomes hysterical, laughing immoderately, hence the name *"laughing gas."*

Table of Oxides of Nitrogen.

Names and symbols:—

Nitrous Oxid (N_2O) also called Nitrogen Monoxid.

Nitric Oxid (N_2O_2) or (NO) also called Nitrogen Dioxid.

Nitrous Anhydrid (N_2O_3) also called Nitrogen Trioxid.

Nitrogen Peroxid (N_2O_4) or (NO_2) also called Nitrogen Tetroxid.

Nitric Anhydrid (N_2O_5) also called Nitrogen Pentoxid.

EXPERIMENT NO. 123. Preparation of Nitrogen Monoxid from Ammonium Nitrat (NH_4NO_3).

Put 10 grams of ammonium nitrat into a plain thin glass Erlenmeyer or Florence flask of 250 cc. capacity. As a precaution of not breaking the glass, put in not over 5 cc. of water. Have a one-hole stopper (rubber) carrying a right-angle delivery tube leading just thru a two-hole stopper in an empty 8 ounce bottle, from which another tube leads to a trough with inverted bottles filled with water. See Fig. 114. Set the apparatus on an asbestos pad over a tripod, or on the ring of the ring-stand, and apply at first gentle heat, which may afterwards be increased, but the action should not be permitted to become too vigorous. If necessary, take away the lamp, temporarily. As usual, the first portions of the gas to pass over the delivery tube should be rejected. If there is any evidence of back suction of the water from the trough to the bottle, disconnect the stopper in the latter for a minute.

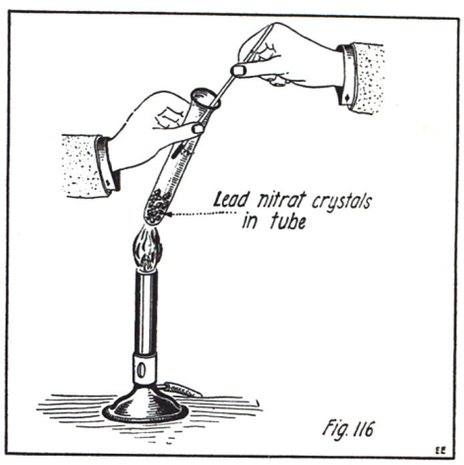
After collecting about four jars of the gas, take away the lamp and *at once either loosen the stopper in the bottle or take the delivery tube out of the trough.* When you disconnect the apparatus thrust a lighted splint into the gas in the flask. Note the phenomenon. When the flask is cool enough to permit being handled, pour in water thru a funnel and dissolve the residue. Test the gas that has been obtained. (See following experiments.) If a liquid is in the intervening bottle, test it with litmus. This gas is commonly called *nitrous oxid;* by dentists simply *gas.*

EXPERIMENT NO. 124. Properties and tests.

Note whether the gas in the various bottles is clear or mixt with some visible impurity. If it is impure, note any variabilty in that collected under greater or stronger heat. Try and determine whether such impurity is of a solid or gaseous nature. With a glass plate (as described in the Lesson on experiments with Oxygen) take one of the jars from the shelf or tray, try the odor of the gas, and then test it with a glowing splint several times, and keep the product, that is the gas which is obtained after the introduction of the splint, covered to prevent escape.

What gas does it resemble in its combustion test? In that case what do you suppose the product to be? Formulate a test for the product which you surmise, and apply this test to determine whether your conclusion is correct. If you were wrong try and find out just what the product is.

Try the action of burning surful in another receiver of nitrogen monoxid, using a carbon cup in the customary manner.



How to Demonstrate the Presence of Oxygen In Lead Nitrat. Lead Nitrat Crystals are Heated in a Test Tube

Note the color of the flame, vigor of combustion as compared to that in air, and test the product of combustion (Odor and Potassium Bichromat Solution). Try the action of burning phosphorous in the gas, noting color, vigor and product. Write the equation if possible, and test the product of combustion. Compare this gas with oxygen as regards *any single property.*

EXPERIMENT NO. 125.

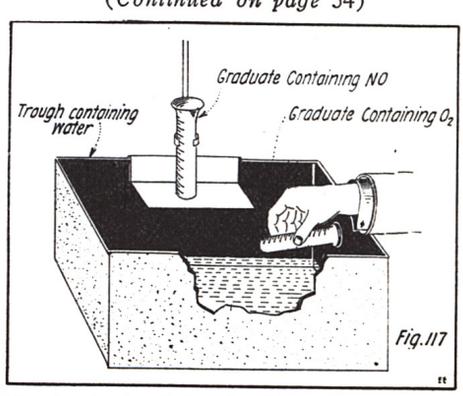
Nitrogen Monoxid and Oxygen. Nitric Oxid Test.

As nitrogen monoxid, (or nitrous oxid (N_2O),) acts very much like oxygen, especially in regard to combustion, it becomes necessary to distinguish the two gases. The following experiment gives a simple method:

Prepare two botles of nitrogen dioxid (NO) (preferably in separate trays or troughs), by the action of Nitric acid on copper. Prepare also an oxygen generator (See Lesson on Oxygen) using potassium chlorat and manganese dioxid, and let the oxygen bubble up into one of these receivers filled with the *nitrogen dioxid.* Continue the operation as long as necessary to determine the nature of the result. Notice any phenomena which are occasioned.

Then generate nitrogen monoxid (N_2O)

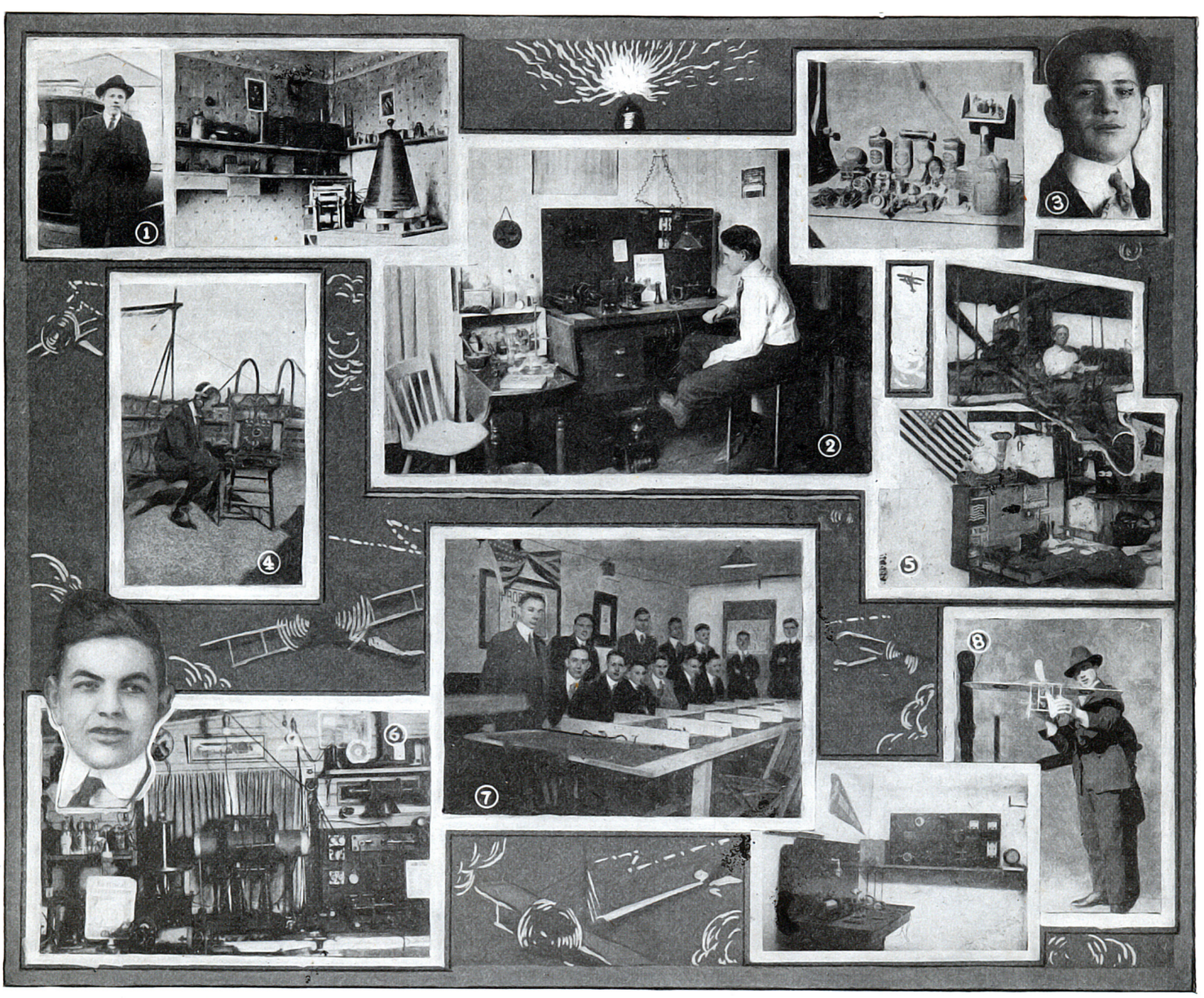
(*Continued on page* 54)



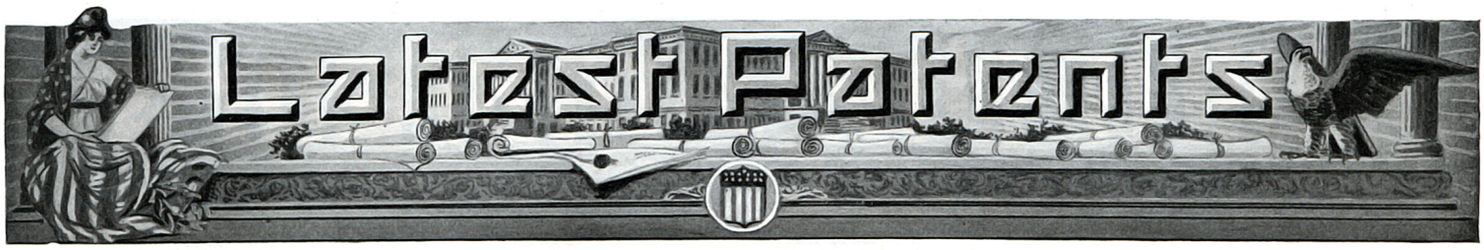
The Contents of the Graduate O_2 are Poured Up Into the Graduate NO, thus Producing NO_2 from NO and O_2 Dissolved in Water.

"Electrical Laboratory" Contest

In the March issue we publisht an interesting story with a number of excellent photos, describing one Amateur Electrician's experimental laboratory. Now "Bugs"—we want to publish similar articles each month. Here's our proposition: Why not write up your "Electrical Lab." in not more than 500 words. Dress it up with several good, clear photographs. If we think it good enough we will publish the article in display style and pay you well for it. The remuneration for such articles will range from $5.00 to $10.00. And "Bugs"—don't forget to make your article interesting. Talking about Radio Amateur activities, we wish to mention the "Prospect Radio Club" of Brooklyn, N. Y., whose picture is reproduced herewith. Here's the right idea, "Bugs." A course in Radio was started last October, with the object of training the members to take the First Commercial license examination. Lectures, which are part of the course, are illustrated by projections and experiments. A practise class has also been started in conjunction with the course, to get up a speed of at least twenty words per minute. The officers for the term are as follows: President, L. Jacquet; Vice-President, Mr. C. Hild; Secretary, Mr. W. Benson; Treasurer, Mr. D. Langan. The Club would like to hear from other Brooklyn clubs, and welcomes visitors to their meetings. Address all communications to the Secretary, Mr. W. Benson, No. 4 Fuller Place, Brooklyn, N. Y. Get ready to help your Uncle Sam!!! Send all laboratory photos to Editor "With the Amateur's Prize Contest."



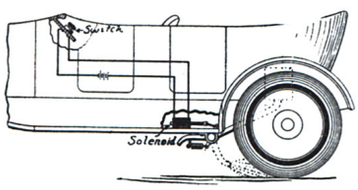
A GROUP OF REPRESENTATIVE AMERICAN AMATEUR LABORATORIES.
Electrical Laboratories of, 1—Edward Olson, Mt. Vernon, Wash. (Prize Winner); 2—J. Wilbur Mudge, Elkhart, Ind.; Radio Laboratories of, 3—S. L. Choldin, Chicago, Ill.; 4—R. Morris, Brooklyn, N. Y.; 5—F. T. Riggs, Des Moines, Iowa; 6—J. N. Edwards, Bluefield, W. Va.; 7—The Prospect Radio Club, Brooklyn, N. Y.; 8—Harold A. De Palma, New York, N. Y.



Magnetic Sander for Autos

(1,257,265; issued to Eldridge V. McCulloch.)

An electro-magnetic sanding device for use on automobiles and similar vehicles. A simple switch mounted on the dash within easy

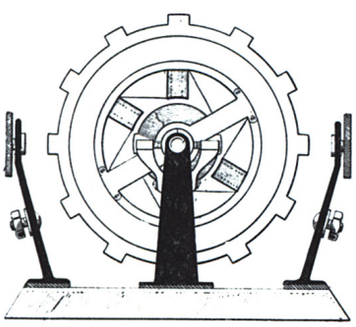


reach of the driver, connects with a storage battery and two solenoid actuated sand box valves as shown. One solenoid and valve is placed on each side of the car, the sand box being placed under the rear seat. Also there are provided two nozzles which swing downward toward the road-bed whenever the magnets are operated and sand released thru the valves. A coiled contractile spring normally pulls the sand valves shut and the nozzles to a neutral position.

Combined Rotary Gap and Motor

(1,250,385; issued to C. H. Teall.)

Combined form of rotary spark gap as used in radio-telegraphy, together with driving motor in-built into frame of gap as illustrated. The rotary gap member is arranged to form the rotor of a motor, the stator of which is located within and concentric with the rotary gap member and thus the latter may be driven at any suitable speed by the

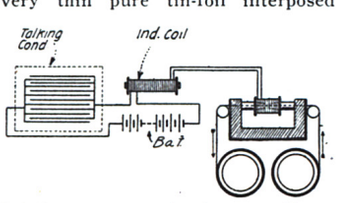


motor embodied within the device. The motor is adapted to be operated on battery or other current. The poles of the rotor are wound with coils of wire, as well as those of the stator, the direction of the current thru the respective windings being periodically changed by means of a commutator.

Talking Condenser

(1,257,075; issued to P. W. Fuller.)

An improved form of voice reproduction apparatus operating on the principle of a condenser. The talking unit proper is composed of a number of sheets of tin-foil interposed between a number of oiled silk or similar dielectric material, connecting the alternate foil sheets to opposite sides of the exciting circuit. The inventor proposes a talking condenser made up of 100 sheets of very thin pure tin-foil interposed



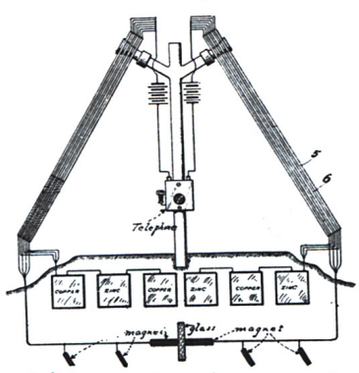
lightly , so as to be free to vibrate between an equal number of smooth paraffined paper, each sheet being

denser, an induction coil, and a source of variable primary current as produced by a telegraphone, etc.

Magnetic Aerial

(1,255,646; issued to P. J. Ruddy.

This invention relates to a magnetic aerial instrument which is supposed to transmit wireless telephone speech, etc. It involves the use of an aerial composed of steel wires, spaced apart by electric conductors, each steel wire being divided into a plurality of magnets, with poles alternating. The aerial cables are composed of alternate steel and copper conductors 5 and 6. The aerial terminals are con-5½ by 8¼ inches. A 250 volt current is connected up with the con-

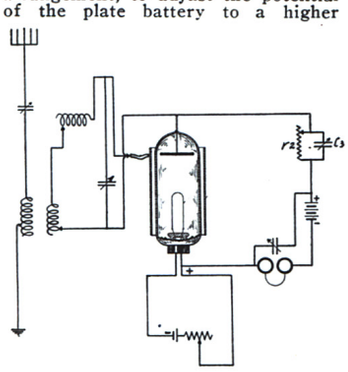


nected to a system of copper and zinc plates, also to a net-work of magnets buried in the ground. The magnets in the earth are supposed to accumulate electro-magnetic waves and the electro-magnetic waves in the air are taken up and amplified by the arrangement of alternate magnets of the aerial cables.

Radio Signaling Apparatus

(1,252,520; issued to Roy A. Weagant.)

A novel vacuum bulb radio receptor adapted for receiving of damped and undamped oscillations. The secondary system comprises a condenser, loading coil and the coupler secondary inductance. The oscillation valve includes the usual plate, metallic envelope and filament. A special feature of this circuit is the plate circuit resistance, "r2," and the shunt condenser, "c3." The inventor claims to be able, by this arrangement, to adjust the potential of the plate battery to a higher

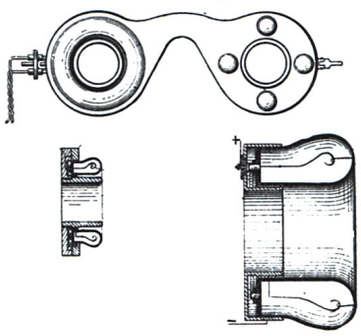


value than is possible without its use. Excellent amplification is thus said to be attained, owing to the critical adjustment of the valve obtained. The valve can be caused to oscillate at the desired frequency by properly adjusting the condensers in the circuits, filament temperature and plate battery potential.

Illuminated Spectacles

(1,255,265; issued to L. Zachara.)

A novel patent on an illuminated spectacle frame to be worn by a person doing special work and intended to enable the person to see

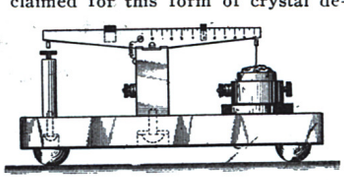


the work clearly, without eye-strain. Also both hands of the wearer are left free. A hollow socket and a passage thru the center of the lamps is provided, a dark sleeve inside the passage of the lamp enabling the user to see the object clear. The eyes are said to be further protected from over-straining by limiting the view thru the openings. Provision is made for using colored lamps or color screens when desired. The strength of the lamps may also be varied according to the weakness of the eyes.

Minneral Detector Stand

(1,257,526; issued to G. W. Pickard.)

An improvement in constant-pressure solid rectifiers, in which the adjustment of pressure of the contact point on the mineral is effected by a balanced bar, similar to a scale. Among other superior features claimed for this form of crystal de-

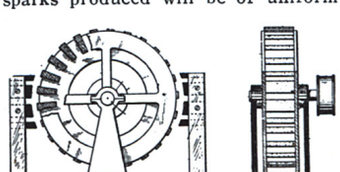


tector stand are: Increased rectifying efficiency of practically all solid rectifying minerals, greater ease of adjustment and of accurate duplication of pressure adjustment. Galena is cited as one of the minerals wonderfully improved by the apparatus, reaching an efficiency unattainable heretofore in spring contact detector stands, on account of its low degree of stability and its great difficulty of adjustment. The number of operative contact points on the galena or other mineral is greatly increased with this constant-pressure contact.

Spark Gap

(1,256,405; issued to Harlan S. Webster.)

An improved form of spark gap intended for radio or X-ray requirements. It is made in the form of a rotary blower as shown, thus creating a powerful cooling effect. Another object is to provide in such an apparatus means whereby the sparks produced will be of uniform

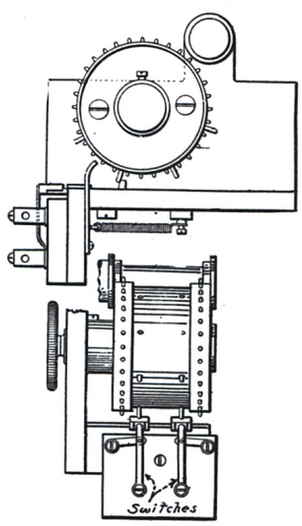


length. The stationary electrodes are alined with and in proximity to the revoluble electrode, each stationary electrode being disposed concentrically to the shaft of the rotary member, thus preventing variation in the length of the spark gap during rotation.

Talking Picture Control

(1,254,436; issued to H. W Rogers.)

A new method of producing talking motion pictures, especially the synchronizing of the voice apparatus with the picture projector. The device is applicable to the film magazines of the motion picture projectors now in use. The film in the present instance is past around a rotating drum which is provided with a plurality of sliding pins. As the drum revolves with the film, the pins are projected thru openings in



the film, and thus brought into contact with a switch closing device. This switch, in co-action with the perforations in the film, is thus caused to synchronously control one or more sound reproducers, such as phonographs. The drum pins are projected radially outward by gravity, aided by a magnet.

Wireless Telephone

(1,256,554; issued to Walton Harrison.)

A unique wireless telephone scheme, whereby the usual complicated apparatus is dispensed with. Instead of using an arc or other recognized form of radio-frequency oscillation generator, Mr. Harrison

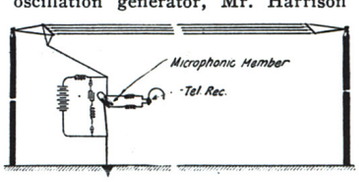


Fig. 1

Fig. 2

makes use of a special microphonic member, connected up as shown. Ordinarily no auxiliary condenser and inductance are necessary in the operation of the system, the inherent capacity and inductance of the antenna-earth system serving the purpose. The hook-up delineated is suitable, the inventor states, for both transmitting and receiving speech or music. Suitable choke coils are provided. Very low voltages are available in this system. Oscillations are set up due to the inherent instability of a low-resistance microphone specified. The microphone also acts as detector.

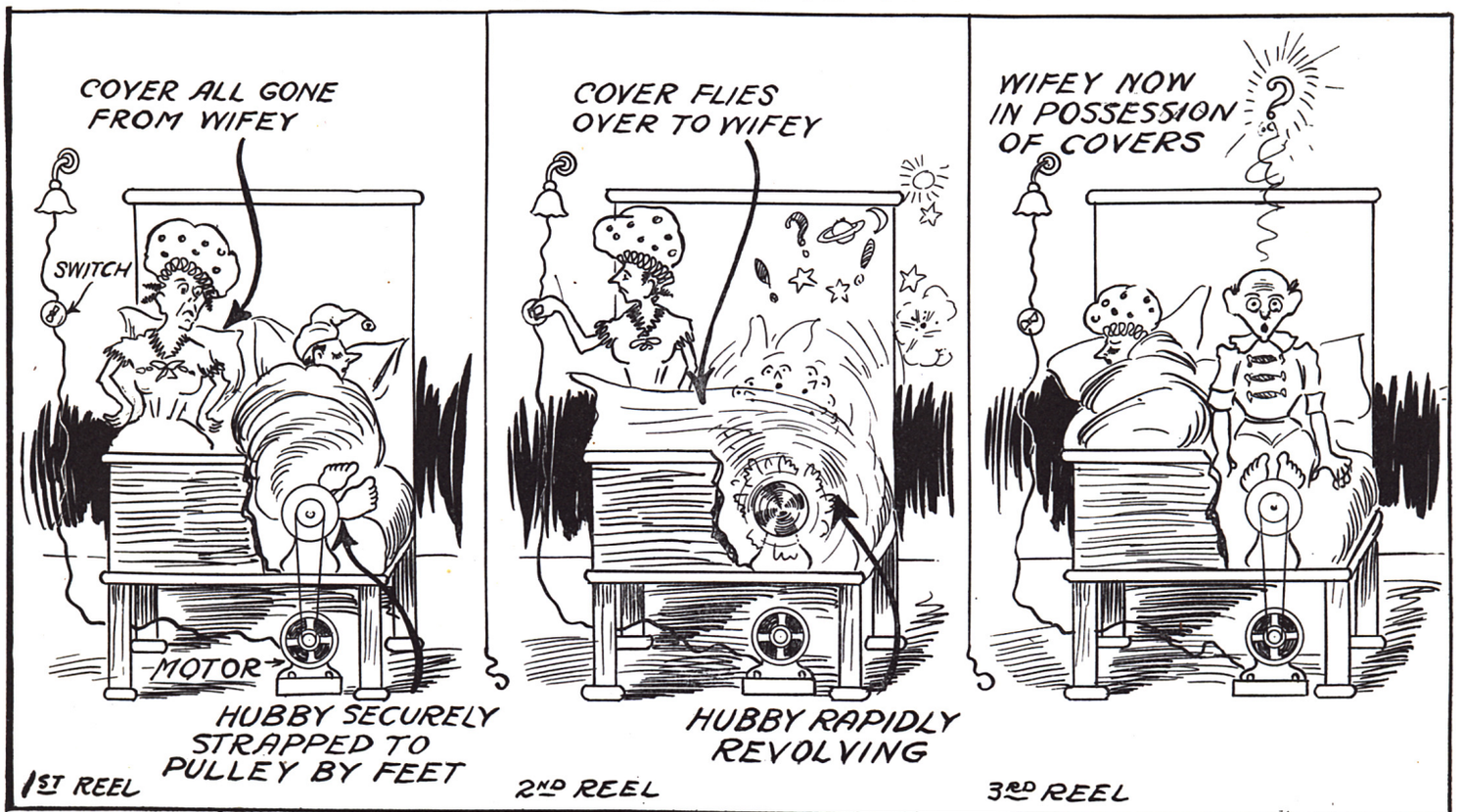
COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c EACH.

Phoney Patents

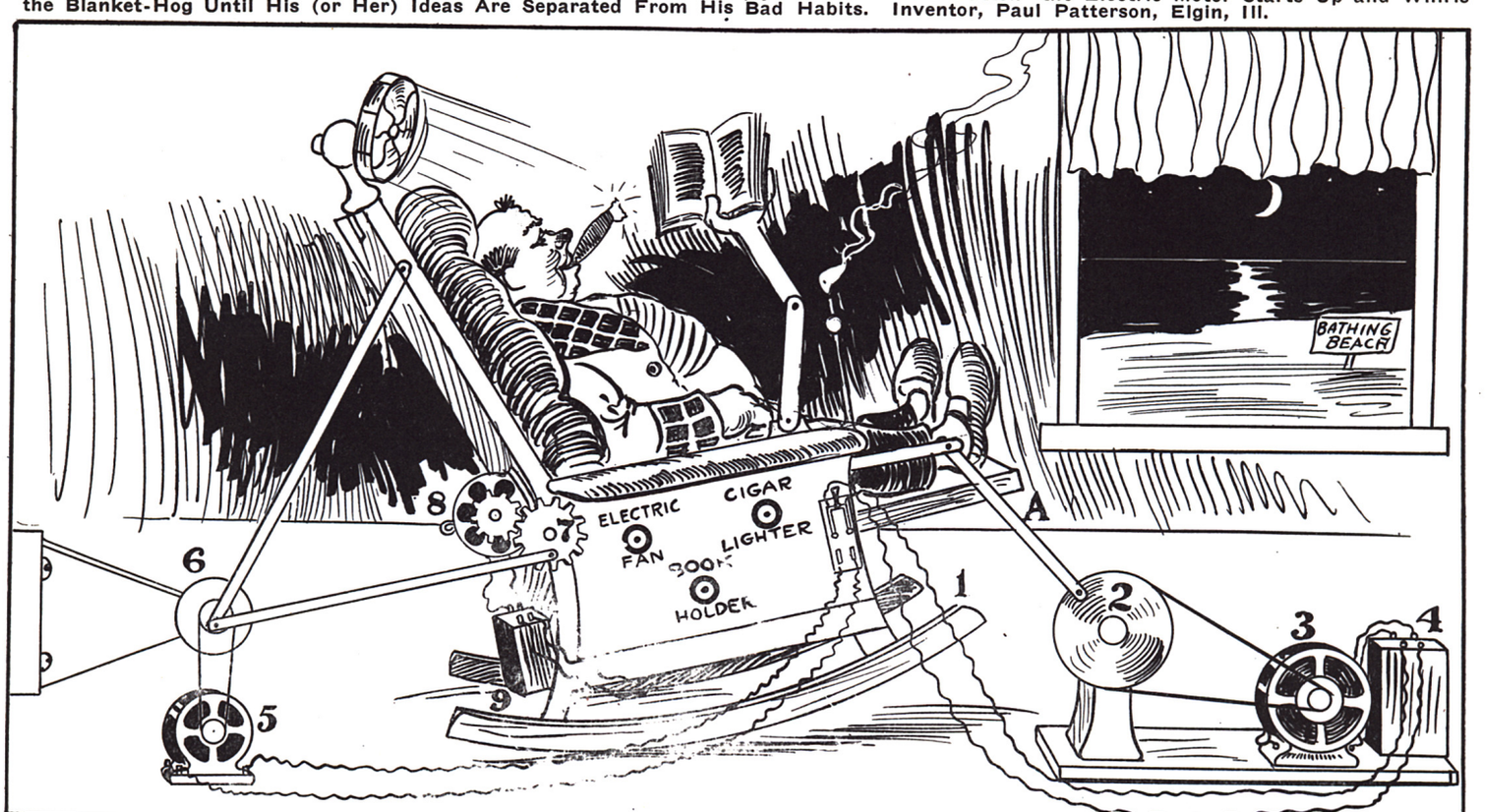
Under this heading are publisht electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00!! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of Phoney Patent examiners to issue a Phoney Patent on your invention in a jiffy.

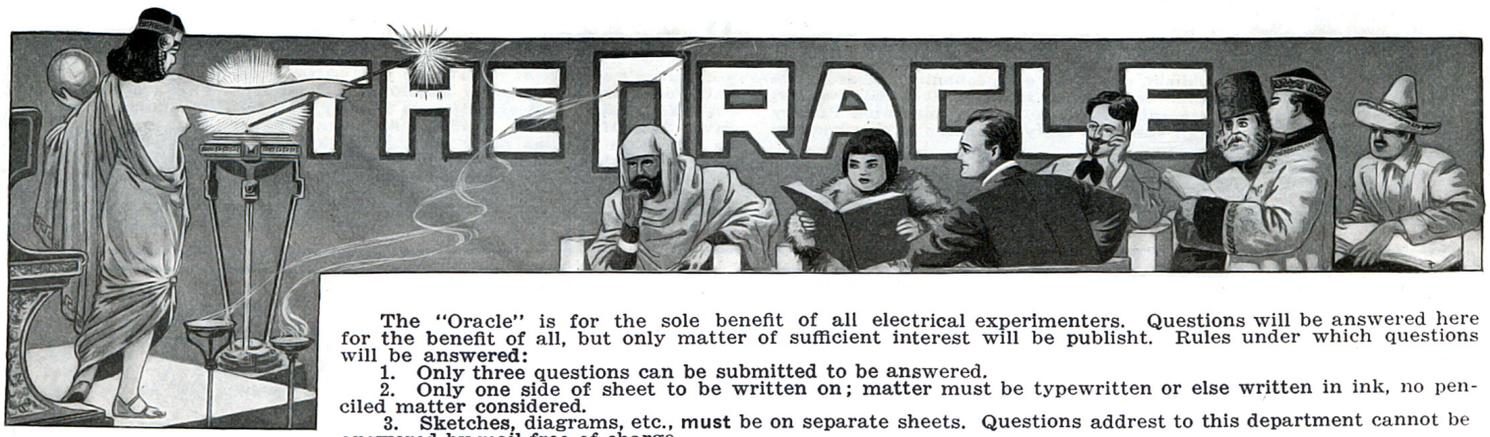
PHONEY PATENT OFFIZZ



Prize Winner. ELECTRIC QUILT REVERSER. Remember Those Bitter Cold Winter Nights When You Woke Up at 12 G. M., With Nothing On You But Your Night-gown? Those Frigid Experiences Are Now Gone Forever, Thanks to My Wizard "Electric Quilt Reverser." If Wifey (or Hubby, If He Gets the Preferred Position First) Awakens and Finds the Other Branch of the Family Tree All Cozied Up in the Only Six Blankets in Sight—Presto! the Said Victim Simply Has to Press a Button—the Electric Motor Starts Up and Whirls the Blanket-Hog Until His (or Her) Ideas Are Separated From His Bad Habits. Inventor, Paul Patterson, Elgin, Ill.



Electric "Comfy Chair." The Days of the Old Man's Club Are Numbered, for Behold the Latest Electrically Equipt Club Chair! It is Equally Efficient in a 2 x 4 Harlem Flat, for Which a Special Collapsible Style Has Been Invented, or At the Seashore. It Keeps the Old Man Home Nights—a Great Boon to Young as Well as Old Wives. As He Rocks He Drives a Dynamo, Which Charges a Storage Battery. This in Turn Runs a Motor for Rocking the Chair, as Well as Supplying Current for the Electric Cigar Lighter, Fan, Book Holder, Back Scratcher, Et Cetera, Ad Lib, Ad Infinitum. It's Great, Boys, Try It! Inventor, Le Roy Nisbet, Battle Creek, Mich.



The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

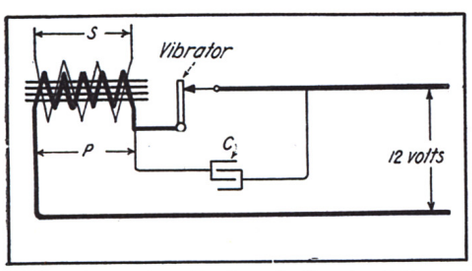
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., **must** be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

2-INCH SPARK COIL DATA.

(918) Geo. A. Detrick, Vinton, Iowa, inquires:

Q. 1. How to wind a two-inch spark coil.

A. 1. To build a two-inch spark coil, use an iron core made of soft iron wire about



Connections for Parts of Spark Coil. A Small Condenser is Shunted Across the Vibrator to Absorb the Spark and Improve the Efficiency.

7 inches long and 5/8 of an inch in diameter, upon which wrap two layers of Empire cloth. Now wind on two layers of No. 16 B. & S. double cotton covered magnet wire which is approximately 190 turns. Over this primary, wrap 6 layers of Empire cloth, and wind on the secondary in two sections, with No. 36 enameled magnet wire, 1½ lbs., of which will take care of the sections very well.

The primary condenser should consist of about 1,400 square inches of tin-foil, interleaved with paraffined paper. The connection should be as per diagram.

CONDENSER TROUBLE.

(919) J. C. Muirhead, Nova Scotia, Can., asks several condenser questions.

A. 1. We would advise that in building a glass plate condenser, where the lugs were omitted, *i. e.*, the tin-foil was merely cut to the desired area, the best way to connect the lugs to the condenser so that the condenser when completed can be immersed in oil, would be to simply cut some extra strips of tin-foil and lay one strip on each piece of tin-foil already cut. These should be of sufficient length to protrude from each end; proceed to make connections with the protruding foil tabs.

Concerning your glass plate condenser, which has been built in three sections; when one section is connected to transformer, the spark obtained is O. K., but when three are connected to the transformer the plates are apparently punctured. The reason for this can only be that in one or more of the condensers there is defective insulation. Therefore, the best remedy is to connect the three condensers one at a time, and see if proper results are obtained.

MICROPHONE "PACKS."

(920) Wm. J. Murdock, Clinton, Ind., says:

Q. 1. I have a microphone which fails to release a relay connected to it as soon as voice waves cease. How can I remedy this?

A. 1. We believe the trouble you are having with your transmitter is due to the coherence of the carbon grains, which are enclosed in the transmitter chamber. The only method by which you can perform the functions of which you speak in your question is by employing a positive contact transmitter. Such a type has been devised and perfected by Mr. Christian Berger, which device has been thoroly described in the October, 1915, issue of the ELECTRICAL EXPERIMENTER in an article entitled "Electric Toys."

ODD PHOTOS WANTED AT $1.00 EACH ! ! !

Now is the time to make your Kodak pay for itself in a real practical way. We are after interesting photographs of out-of-the-ordinary electrical, radio and scientific subjects and are willing to pay $1.00 *cash for every one we can use. Please bear in mind that for half-tone reproduction in a magazine, a photograph should be particularly sharp and clear. Of course, if a subject happens to interest us particularly well, we can have the photo retouched. For the general run of subjects, however, it does not pay to go to such expense. Therefore, please take pains to properly focus and expose your pictures. It often happens that a really mediocre subject well photographed wins approval over an excellent subject poorly photographed. And don't send us plate or film "negatives"; send unmounted or mounted "prints," preferable a light and a dark one.*

As to what to photograph: Well, that's hard for us to say. We leave that up to you, and every reader now has the opportunity to become a reporter of the latest things in the realm of Electricity, Radio and Science. But, please remember—it's the "odd, novel or practical stunts' 'that we are interested in. Every photo submitted should be accompanied by a brief description of 100 *to* 150 *words. Give the "facts"—don't worry about the style. We'll attend to that. Enclose stamps if photos are to be returned and place a piece of cardboard in the envelope with them to prevent mutilation. Look around your town and see what you can find that's interesting.*

Address photos to—Editor "Odd Photos," ELECTRICAL EXPERIMENTER, *233 Fulton Street, New York City.*

THERMO-COUPLES.

(921) M. Lompi, Albany, N. Y., asks:

Q. 1. What are the thermo-couples that will answer the Peltier effect?

A. 1. All thermo-couples will exhibit the Peltier effect, which is made evident in the following manner: In any thermo-couple where the junctions are of different temperatures, currents of electricity will flow in the circuit, which involve the expenditure of energy as heat, according to Joule's law, and there will be an increase or a decrease of the current in the circuit depending upon the *direction of the flow* of the current in the main. Heat developed due to the Peltier effect varies directly as the current produced, which differs from the heat developed in any other electrical circuit, in that the heat developed varies as the square of the current.

Q. 2. How are thermo-couples made?

A. 2. Thermo-couples are easily made by simply heating dissimilar metals at their junctions. The thermo-electromotive-force increases with the increase of the temperature, within certain limits.

Q. 3. What book treats on their action?

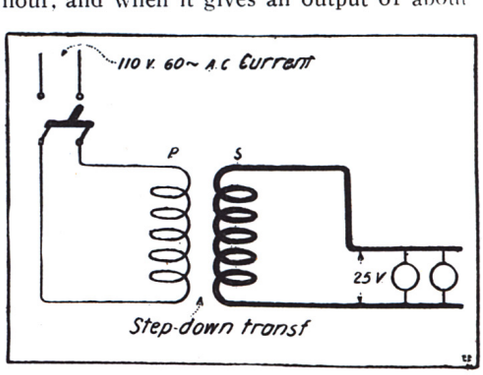
A. 3. We recommend the "Elementary Lessons in Electricity and Magnetism," by Sylvanus P. Thompson, supplied at $1.50 net.

STEP-DOWN TRANSFORMER.

(922) J. W. Fickler, Mason City, Iowa.

Q. 1. Hook-up and kilowatt-hours consumed by a certain step-down transformer.

A. 1. When you are obtaining an output of 25 volts and 25 amperes, the transformer will be drawing about 6½ amperes, and when you are drawing 25 volts and about 50 amperes the transformer will be consuming about 13 amperes. When the transformer is giving an output of 25 amperes it consumes about 72/100 of a kilowatt-hour, and when it gives an output of about



The Light and Heavy Lines Show the Relative Voltage Proportions in a Step-down Transformer. As the Voltage Reduces at the Secondary, the Current Increases, So That the Watts Remain Almost the Same.

50 amperes it takes about 1.44 kilowatt-hours.

We give herewith a diagram of correct connections of such a transformer:

(*Continued on page* 48)

I Will Teach You Electricity
Practically—Thoroughly—Quickly

A. W. WICKS, Bach. Sc. E.E.

formerly with the General Electric Company; former General Manager of company manufacturing Jenney Electric Motors; also formerly with Fairbanks, Morse & Co.; now Consulting Engineer, President and Director of the Wicks Electrical Institute.

IF you are ambitious to get ahead quickly and surely, write to me. I want to tell you how you can become a proficient electrician by home study in your spare time. For twenty-five years I have been an Electrical Engineer and the experience I have gained in all kinds of electrical work I have put into this course which I offer you on easy terms.

The government has taken thousands of electricians for war service and needs more. And those who have gone have left places which must be filled. Here is opportunity for you. Why not take hold of it? Get the training which will equip you to enter the electrical field at the very time when the prospects are brightest. All you need is the will-power to use your spare time under my direction. At least write and get all the facts about the Wicks Course in Electricity. See how simple and easy to learn it is. No needless theories. No difficult mathematics. A course for practical use.

Personal Instruction By Mail

I have already helped hundreds to get out of small-paying, no-future jobs. C. A. Walker says: "Wicks training more than doubled my pay." E. Vogel says: "Am successfully installing electrical systems." O. Clausing says: "Offered a fine position." J. Obeslo says: "Have a chance to run city electric plant." I gave them their training by mail, just as I can give it to you. While you are drawing your present salary I can prepare you for a good electrical job or for a business of your own. Say to yourself now—"I will do it"—and then send the coupon below.

What You Can Earn

You know what good electricians make. If you are not sure that this is a paying business, look into it. Find out what salaries electric light and railway superintendents, telephone engineers, dynamo and motor experts and other electrical men draw. See how busy every electrical contractor and supply dealer is. Are *you* doing as well as these men? If not, why don't you get started? Look ahead. Take advantage of circumstances which have created this big present demand for electricians.

When I say that you can make a good income from electricity, I say just what you know yourself. I don't promise that you are going to step into $8000 a year—and any school which leads you to think that *every* man who trains in electricity can earn such an income as that is going beyond the limit of reason.. Some electricians do make that much and more but they are above the average—So don't accept big promises. Get the facts.

What I promise is to give you a thorough, practical education in basic principles and in the methods followed by the best electricians. I will give you my personal instruction, step by step, until you graduate, and afterward if necessary. I know from what my graduates report that, unless you are making over $25 a week with good prospects for a raise, you can study electricity to big advantage. There is all the opportunity in this field that any ambitious man can ask for. If schools which promise $8000 salaries can really help you to earn that much—surely this training ought to put you in line for even more.

Pay as You Learn. There is no big amount to pay at any time. Only a small payment down and a little each month pays for the course. I'll be with you at every step.

FREE
Personal Analysis

Before you enroll, I ask you to fill out a Personal Analysis Sheet which enables me to tell just how well qualified you are to take up Electricity. Upon receipt of this I will advise you frankly whether to enroll or not. This enables you to know just what *you* may expect to gain from this course. No charge for this service, and no obligation upon you.

Send Coupon for Opportunity Book and Special Personal Analysis

If you are now in an occupation that promises only the ordinary or a doubtful outlook—if you are now an electrician ambitious to make quicker advancement, to better income—send without fail for this important book and Personal Analysis Report. Find out about this course. See what it offers. Let Prof. Wicks explain his method of teaching. Learn how you can put yourself years ahead by his personal instruction sent right to your home. The Book, the Personal Analysis and all this information sent free. Also information on the easy monthly terms which puts this course easily within your reach. Don't put this off. No obligation or promise on your part. Send the coupon now.

ALBERT WOOD WICKS, B. Sc. E. E.
Pres. and Director **WICKS ELECTRICAL INSTITUTE**
81 W. Randolph St., Dept. 309, Chicago

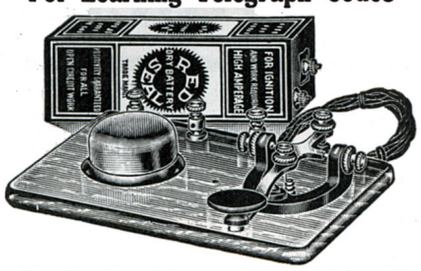
Send this COUPON
A. W. WICKS, Bach. Sc. E. E.
Pres. and Director
Wicks Electrical Institute
81 West Randolph Street, Dept. 309, Chicago, Ill.

Without any obligation on me whatever, please send me the Opportunity Book with instructions in Electricity; also the Special Personal Analysis.

Name .....
Street and No. .....
City ..... State .....

Mesco Telegraph Practice Set

For Learning Telegraph Codes



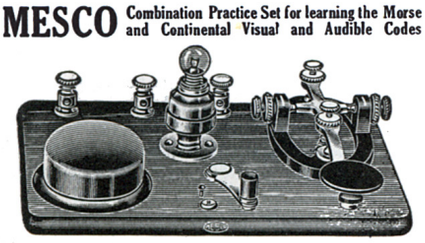
The Practice Set comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal Dry Battery, and four feet of green silk covered flexible cord.

The key and buzzer are mounted on a highly finished wood base, and three nickel plated binding posts are so connected that the set may be used for five different purposes.

List No. Price
342 Telegraph Practice Set, with Battery and Cord $2.70

Weighs 4 lbs. packed.
Price does not include postage.

MESCO Combination Practice Set for learning the Morse and Continental Visual and Audible Codes



This outfit is the only reliable instrument which will enable students to become proficient operators in the U. S. Naval Service, because it is equipped with a buzzer and miniature lamp enabling the user to master both the visual and audible signals quickly.

List No. 52—Practice Set with Red Seal Battery and Cord $3.60

Weighs 4 lbs. packed. Price does not include postage.

Send for the New Edition of Our Catalog W28

It is pocket size, contains 248 pages, with over 1,000 illustrations, and describes in plain, clear language all about Bells, Push Buttons, Batteries, Telephone and Telegraph Material, Electric Toys, Burglar and Fire Alarm Contrivances, Electric Call Bells, Electric Alarm Clocks, Medical Batteries, Motor Boat Horns, Electrically Heated Apparatus, Battery Connectors, Switches, Battery Gauges, Wireless Telegraph Instruments, Ignition Supplies, etc.

Send for the Catalog Now

Manhattan Electrical Supply Co., Inc.

NEW YORK: 17 Park Place
CHICAGO: 114 S. Wells St.
ST. LOUIS: 1106 Pine St.
San Francisco Office: 604 Mission St.

Learn Shorthand in Five Hours

You will be amazed at the ease and quickness with which you learn the wonderful K. I. shorthand. In a few hours you'll know the whole system and can then gain speed in taking down dictation, conversation, speeches, orders, etc., as fast as a person talks. A free lesson will be mailed by King Institute, EB-300, Station F, New York, N. Y. Just write for this and see what you get. Astonish everybody with your ability and earn more money.

Feldman's "Geyser" Electric Water Heater

Instantaneous Hot Water

FELDMAN MFG. CO.

1514 Times Bldg. New York City

THE ORACLE.

(*Continued from page* 46.)

SUBSTITUTE FOR PLATINUM.

(923) R. B. B., New Jersey, asks:

Q. 1. Several questions relative to a substitute for platinum, particularly a composition known as "Densite."

A. 1. Relative to "Densite" as a substitute for platinum, we would advise that if it stands up to the tests mentioned by you it is certainly a good substitute for platinum.

We would further say that platinum is universally used wherever the best contact is desired, and that consumed for the purpose amounts to a very large quantity yearly. There are, however, other materials on the market that are substitutes for good contacts, such as silver, tungsten, steel, etc. Therefore, a proposition wherein an excellent substitute for platinum is had at 10 per cent of the prevailing cost of platinum is really a very good one, we should say.

HEATING COIL OPERATED ON BATTERY.

(924) M. O. Dellinger, Wolcott, Ind., asks:

Q. 1. Can I produce one thousand degrees of heat in the hollow core of a small coil operating on a six-volt storage battery? How much wire, what size and kind shall I wind it with?

A. 1. It would be impractical to produce a temperature of the intensity you state from a six-volt storage battery for any considerable length of time.

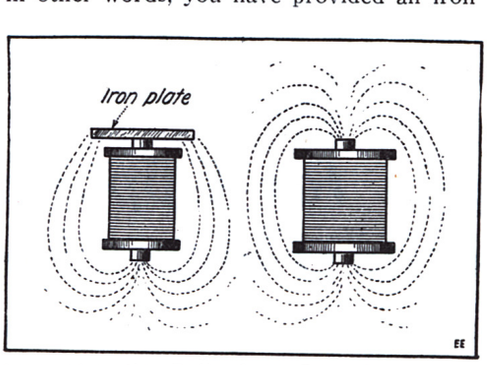
However, a coil can be made out of *constantin* wire, No. 24 gage, and if about fifteen feet of this wire is used, wound into coil form, it can then be employed for producing a high temperature of about the intensity you desire.

ELECTRO-MAGNET QUERY.

(925) Jos. Macowick, Ravenna, Nebraska, writes the "Question Box":

Q. 1. Would a soft iron plate 4 x 4 x ¼ inches, secured on one end of an open-core electro-magnet increase its pull?

A. 1. A soft iron plate, measuring 4 x 4 x ¼ inches, if secured on one end of an open-core type electro-magnet, will increase the attractive power at the opposite end of the electro-agnet considerably. This is due to the fact that you have reduced in this way the reluctance of the external magnetic circuit of the electro-magnet, or in other words, you have provided an iron path for part of the flux, which otherwise would have to complete its circuit thru the air from one end of the core to the other (see cut herewith). The air return circuit presents a very high reluctance to the magnetic lines of force. The most efficient type is the closed core solenoid or electro-magnet, in which an iron yoke return circuit is provided.



Increasing the Pull of an Open-Core Type Electro-Magnet by Placing an Iron Plate at One End of It, Thus Reducing the Magnetic Reluctance.

RESEARCH AND ITS IMPORTANCE TO HUMAN PROGRESS.

(*Continued from page* 19.)

ble increments which *anyone* may produce. I do not think due reverence is given to new knowledge. I want to illustrate.

Sometimes, somewhere, centuries ago, the slag of a fireside appeared transparent; someone tried to learn more about it, and so, ultimately, glass was made. Research is still under way on that very material, and countless numbers of men have slowly added to the knowledge. Glass has kept the cold from the house. It has let in the light. It has renewed our eyes as they have worn out. Thru telescope and microscope it has shown us the greatest and the smallest things of the universe. It has bottled our drinks and held our lights. Every year still adds new service, just in proportion as experiments add new knowledge. Today we hear of a new glass permeable to ultra-violet light, glass opaque to X-rays, and glass for cooking utensils. Not one of these little increments will ever be lost, but will continue in use, so how highly should we value them? Why did we delay so long in coming thus far, and how far or fast may we still go?

Research presents a way, and the only certain one, of insuring peace, of preparing successfully for defense, and of being successful in war. It is the lasting, undeviating factor which always dominated. This may sound bold and entirely inconsistent in itself. It is all true. Can we learn to see it? From the military expert to the anthropologist, thinking men recognize that for over 100,000 years war has been almost continuous on the earth. The inventors of chipt flint successfully fought those inferiors who had *not experimented* with flint. There were then no better arms. These also got their game even when it was scarce and other means failed, and so they continued to survive. This little and early example of survival was repeated a great many times before our present complex world conditions were reached, and will as surely continue to be repeated. The fundamentals were always the same. A 42 cm. gun is only a better flint. Trinitrotoluol is only a more modern sling. Arms and ammunition have changed, but just so have also changed the myriads of other important accessories to survival. This is the important point. Good guns go with good clothes, and niter is good for fertilizers and for guncotton. The signs that we are improving in our civilization will also indicate that we are growing in our powers of national defense, but this should come rather as a consequence than as an object. The world has always been improving, and the real growth and development has come to those nations which have been responsible for the *original research work* and not for the *mere storage or conservation of the knowledge.*

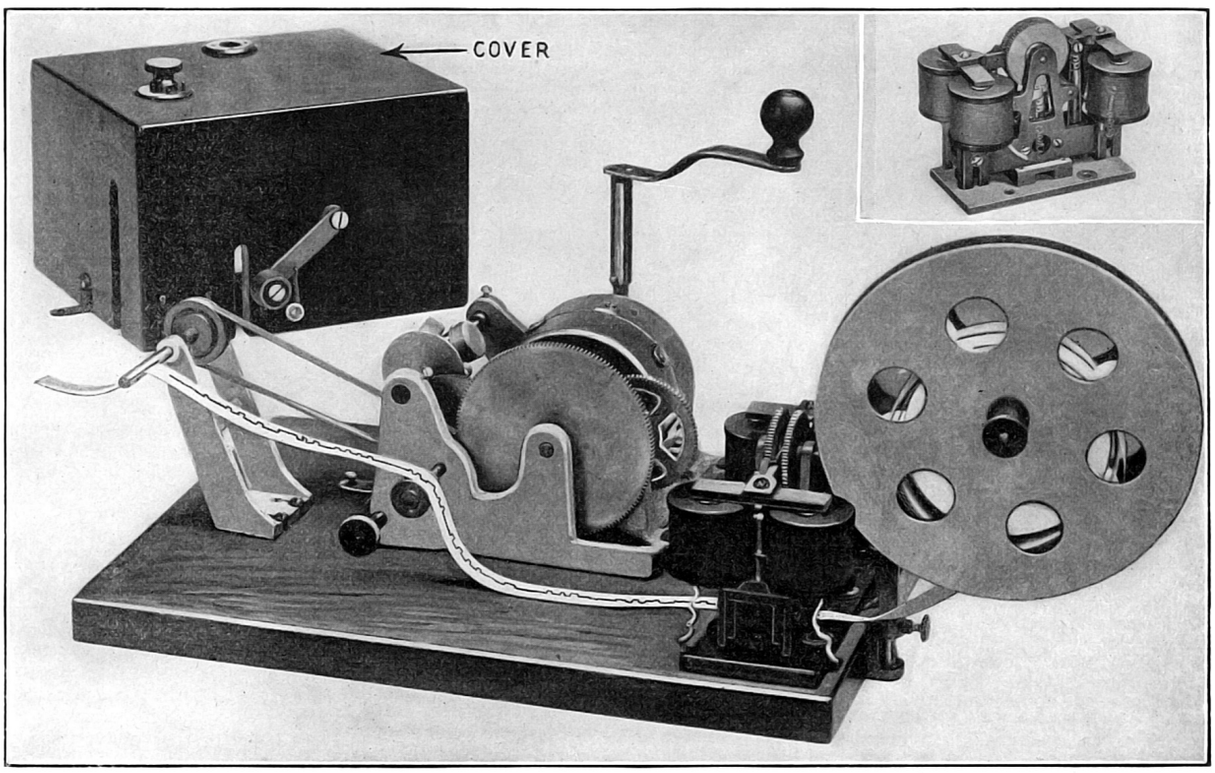
As a means of illustrating how one thread of work starts another, I will briefly review part of a single fairly connected line of work in our laboratory. In 1901 the meter department wanted electrically conducting rods of a million ohms resistance. These were to be one-quarter inch diameter by one inch length.

We learned how and what to mix to get a fair porcelain, and we found that small quantities of carborundum or of grafite would give us the desired resistance *once in a hundred* trials. The rods could be made, but the variation of their resistance when taken from the porcelain kiln, and when they were made as nearly alike as we could make them, was often so many thousand fold that something new had to be done to make a practical success.

(*To be concluded.*)

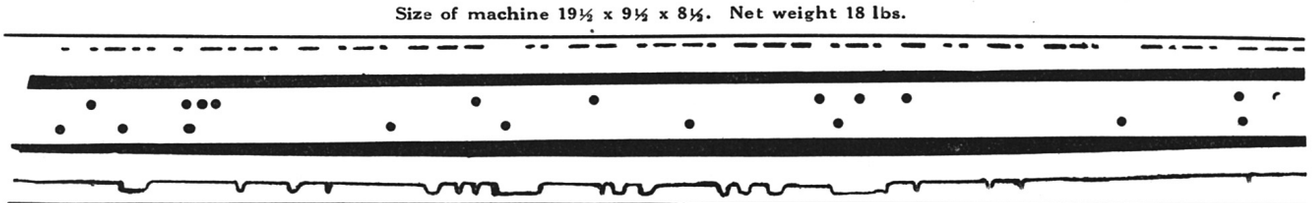
Amateurs! Experimenters!! Opportunity Extra-Ordinaire!

$70.00 for $15.00 ! !



$70.00 for $15.00 ! !

Size of machine 19½ x 9½ x 8½. Net weight 18 lbs.



These 3 tapes show how machine works

STATEMENT BY MR. H. GERNSBACK, PRES'T:

"I have carefully read all the statements contained in this advertisement. Every word is true; nothing has been exaggerated. I believe this to be the greatest bargain,—the greatest value—that has ever been offered by my company to amateurs and experimenters, in its 14 years of existence." ***ELECTRO IMPORTING CO., (Signed) H. Gernsback, President.***

HISTORY

The tape recording and perforating machine here illustrated and described is regularly manufactured by one of the largest electrical companies in the U. S. Some time ago a western telegraph company ordered a goodly quantity of these machines for their regular requirements. As we understand it, they paid over **$70.00** apiece for these recording machines. The machines were duly shipped West by Express, but the telegraph company having financial troubles could not pay the heavy express charges. Thereupon the machines were returned to New York **with added charges,** and were finally sold at auction by the express company to recover the transportation charges, as is customary. **We bought the entire lot of machines.**

DESCRIPTION

This is a standard commercial, large size, perforating, telegraph recorder. It is exactly the same machine as used by the Western Union and Commercial Telegraph Companies in their main offices. This machine requires a double contact (back stop) telegraph key and a few batteries. Pressing the key operates in turn the two sets of powerful electro-magnets, which on their part operate the two ratchet wheels. These then operate two plungers which punch the holes in the tape (see illustration of tape). By sending Morse code, the holes are punched in a certain manner. Then by feeding the tape back thru the machine and by arranging two brass contact fingers, the tape will spell out dots and dashes by means of a buzzer.

This machine has a truly wonderful spring motor. It is absolutely silent and has a centrifugal regulator speed-adjuster and stop arrangement. **At the highest speed the motor runs 18 minutes, at the slowest speed 65 minutes continuously.** Over all dimensions of machine are 19½ x 9½ x 8½. Diameter of holes punched 1/16". The width of paper tape is ½". Aluminum reel 6½" dia. The magnets measure 1½" dia. and are 1¼" high. **The net weight of the machine is 18 lbs.** Our ills. shows machine with cover removed to show motor. The small insert shows the beautiful tandem electro-magnet arrangement, the ratchet wheels and perforating equipment. All wood work is solid mahogany.

USES

What you can do with this beautiful machine:

1ST—USE AS A PERFORATING MACHINE as already described. By means of a block of wood and a few bits of brass (or you can mount them on the base of the machine) you have a regular Morse sender and receiver. You can then ask a good operator to send you a long message and you can listen to the dots and dashes as often as you wish. The tape record thus prepared will last a very long time.

2ND—AS A REGULAR MORSE REGISTER. With instructions which we supply and by using only two magnets (instead of 4) and by making a few slight changes, **which any experimenter can do,** the machine will write regulation dots and dashes on the tape. A pencil lead is used to do this. **You can then hitch an omnigraph to the recorder, and you are now enabled to read the messages by sight.** Or you can send the message yourself with an ordinary key, etc., etc.

3RD—AS A SPECIAL REGISTER. By utilizing all four magnets a special type of dot and dash can be sent (as used in cable telegraphy). See sample of writing on the tape just leaving machine, above. This record can be read just as easy as regulation dot and dash (the dot is represented by the π sign). To send such signals a slight change is necessitated which can be made by any experimenter handy with tools.

4TH—AS A TELEGRAPHONE. Every experimenter has long wished for a real telegraphone, whereby the voice is recorded on a thin steel wire, and then reproduced over a cheap style 75 ohm pony telephone receiver. By means of this machine a very efficient telegraphone can be built by any experimenter handy with tools. No expensive extras are needed; a few bits of brass and steel will do the trick.

We furnish Blue Prints and full Directions to make all the above apparatus using the recorder. We also furnish 3 paper reel tapes, standard size.

Space does not permit listing all of the many good points of the recorder. Suffice it that the machine is the most expensive commercial type, with everything of the very best.

A similar machine is listed at **$100.00** in the catalog of the Western Electric Co. We bought these machines cheap thru auction, hence the ridiculously low price. **AND EVERY MACHINE IS BRAND NEW,** has never been used, and is in perfect working order—or money back.

We have not a very large quantity of these machines on hand and as we know that there exists a big demand for this recorder, we are almost certain that we will not run this "ad" again. This is your one chance,—grab it while the machines last—**you will never see such a bargain as long as you live**—we are quite certain of it.

The size of the machine being 19½ x 9½ x 8½, the net weight 18 lbs. (shipping weight 30 lbs.) make it necessary to ship it by express or freight. We guarantee immediate shipment within 24 hours after receipt of remittance. Order at once—today—so you won't regret. If you live far away you can make telegraphic reservation. In this case we will hold one or more machines awaiting your remittance.

Price as described complete

$15.00

THE ELECTRO IMPORTING CO.

231 FULTON ST., N. Y. C.

"Everything for the Experimenter"

See also our full page ad on page 1.

"LEARNELECTRICS"

DEPENDABLE KNAPP ELECTRICAL SPECIALTIES

Enables learners to grasp all the fundamental rules of electricity.

Complete Electrical and Experimental Laboratory

This is a remarkable collection of instruments, apparatus, materials and a variety of various parts with which numerous electrical apparatus may be constructed as well as a thousand different experiments.

With this set you can build an electric motor, a bell, solenoid, galvanometer, lifting magnets, floating magnets, and you can perform thousands of experiments, including suctional magnets, floating magnets, etc. Outfit also includes box of filings, magnet wire, horse shoe and straight magnet, **INSTRUCTION BOOK** written by H. P. Gorman, A.I.E.E., containing scores of experiments profusely illustrated and covering the entire subject.

Outfit comes in handsome box with fittings for every part. All the experiments can be performed with a screw driver (which is included with the set) and your hands. **$3.25 at all leading dealers.**

If your dealer cannot supply you, order from us and send for free catalog of electrical motors and specialties from 10c upwards.

KNAPP ELECTRIC & NOVELTY CO.
523 West 51st St., N. Y. City

WIRELESS SALE

We have a very large stock of the following items and in order to reduce this stock to existing normal requirements offer the wireless instruments below mentioned at the following remarkable prices. We reserve the right to withdraw this offer and refund remittance when our stock is adequately reduced. Get your station ready now and get quick service. Thousands will swamp us with orders when the war is over.

	Regular Price	Special Price
No. 63X01 Sayville Rotary Gap	$12.00	$7.75
No. A37X88 Type "B" Sayville Rotary Gap	12.00	7.75
2 Point Anchor Gap	.60	.38
Navy Type Receiving Transformer	17.50	13.50
No. 1091 Arlington Transformer	7.50	5.75
No. 1092 Arlington Transformer	6.50	4.95
No. 7721 Rec. Trans.	5.75	3.75
Any of the combined Transmitting and Receiving Sets on pages 90 to 95 of catalog 11 (also listed in earlier editions of catalog) Special discount 20%.		
No. A504 Detector	.95	.75
No. A60X12 Detector	.55	.35
No. A676 Crystal Detector Stand	1.00	.70
No. A7712 Crystal Detector Stand	1.75	1.25
No. 40X01 Standard Detector	1.25	.85
No. 71X18 Rec. Trans.	5.25	3.00
No. A7728 Loading Coil	2.25	1.50
No. 61X08A Mascot Tuning Coil	2.00	1.50
No. 61X10 Tuning Coil	3.35	2.75
No. A520 Jr. Loose Coupler	3.75	2.55
No. A500 Jr. Detector	.75	.50
Parts for No. A7721 Loose Coupler	4.00	2.50
Parts for No. 71X18 Loose Coupler	3.25	2.50

Send 8c in stamps or coin for big 300 page Electrical and Wireless Catalog. Not sent otherwise.

WILLIAM B. DUCK COMPANY
230-232 Superior Street
TOLEDO, OHIO

U. S. NEEDS MEN FOR SEARCHLIGHT REGIMENT.

An excellent opportunity is being offered to young men possessing a knowledge of electricity and mechanics, as well as experienced electricians, gas-engine operators and machinists, to serve the Government effectively in its fight for democracy.

The War Department is organizing a regiment of searchlight companies for special service abroad. These units will be highly specialized and used for battle illumination and anti-aircraft protection. The companies will be armed and equipt as regular military units and will form part of the regular army organization. They will be called upon for extremely active work in the war zone, and pains are being taken in the selection of the personnel of the companies.

WHO CAN QUALIFY?

Men of proper experience who already have been drafted into service may in special cases be transferred.

The plan is to obtain bright, young, intelligent and ambitious men between the ages of eighteen and twenty-one, who possess a fundamental knowledge of electricity and mechanics, as well as trained and experienced electricians, gas-engine operators and machinists. The enlisted personnel will embrace men experienced in one or more of the following occupations: Electrician, gas-engine operator, machinist, motor-truck driver, blacksmith, horseshoer, mechanic and general all-around utility men.

Men must first enlist as privates and will be paid thirty dollars per month, together with food, clothing, medical attention, etc. Non-commissioned grades will be available at rate of pay from thirty-six to ninety-six dollars per month, and future promotion is open to those of ability.

Specialized service of this character offers unusual opportunities for those capable. The character of the work will be highly interesting and varied. The man who has the necessary training and ability cannot serve his country better than by joining such an organization.

The foregoing summarizes the general activities of this new regiment. Information may be obtained by writing direct to the Commanding Officer, 56th U. S. Engineers, Washington Barracks, D. C. The applicant must give the following information: (1) Name; (2) address; (3) age; (4) married or single; (5) nationality; (6) will you enlist for the period of the war; (7) brief statement of education; (8) present occupation; (9) experience; (10) name and address of present or former employer.

SCIENCE IN MODERN WARFARE.

(*Continued from page* 21.)

miles away. By means of "sound ranging" and photographs taken the day before from an airplane, the cannon were sighted correctly and the four shots demolished an enemy battery. Photographs taken after the fourth shot proved it was destroyed.

This is only one example of what goes on every day at the front. Just think for a minute what such a feat means. First, an exact knowledge of the region must be known by means of maps. The preparation of these maps is a stupendous task in itself, involving triangulation from various points and photographs from airplanes and balloons. Next, the characteristics of the enemies' cannon must be obtained and their exact positions in relation to their own battery. After each shot the huge cannon must be put back into position. This is done by finely adjusted optical instruments. Then certain corrections must be made, due to differences in the weight of the shells, the weight, age and quality of the charge of powder, and the age, temperature, and state of erosion of the guns. The atmospheric conditions, such as direction, and force of the wind at different heights, the temperature, pressure and humidity of the air all produce disturbances, which must be taken into account and corrected. All this entails an exact knowledge of many of the sciences. In addition to these the shell must explode at the proper instant and must have a proper "fragmentation." All this means exact application of science.

Acoustics are also used in mining operations, in locating airplanes at night, and in submarine detection.

Photography has also been carried to a very advanced stage. Nearly all successful offensives are dependent on correct maps and ranges, and the taking and correct interpretation of aërial photographs has become a military necessity. The French Army have many schools where the training of observers is carried on, teaching the art of taking photos and making maps from them.

Electricity, of course, has had many applications in warfare, the most important of which is *wireless*. Tens of thousands of portable outfits have been made to supply the armies. The success of wireless has been due to the prevention of interference and sorting out of the messages from among the great mass of signals, for during a battle it is a common occurrence for more than *fifteen hundred separate stations to send messages simultaneously*.

In chemistry the application has been in asphyxiating gases and tear-producing gases and, of course, in the making of gunpowder. In France alone there are over twenty-five different laboratories engaged in research work on nitrogen fixation.

VOL. 6, NO. 1.

(*Continued from page* 17)

flipd a coin to see which way hed go, seller or seiling but the coin fell in a crak in the floar and then he got awfulli soar en sed to the printr heds i lose, tales you win. An then he took a deap breth an sined the kontrakt?!?! So pleas deer friends all of you 100,000, wont you pleas sit down NOW and write to my advertisrs so that *theil* know how mani good frends I reeli hav. You see advertisrs are awfulli distrustfull fellos, thei think i only got maibe 50,000 frends. Now wont you prov to em that thei hev enother gess koming.

Yours till the juis givs out,
ELECTRICAL EXPERIMENTER.

Be Your Own Photographer by Using Atlas Jr.

Ready for instant use, one bottle making one gallon of solution, which will last for several months. Good for plates, film and paper.

50 cents the 3 ounce bottle, postpaid.

Write for our price list.

CARROWAY CO., Chemicals,
86 Dey St., N. Y. C.

TELEVISION AND THE TELEPHOT.

(*Continued from page* 13)

The disposition of this black plate and the telephone receiver is shown in a separate detail sketch, *T* being the receiver, *D* the diafram, *E* the plate. At *A*, we have a source of light, as for instance an electric lamp, which emits parallel rays of light which are somewhat modified by the transparent plate in front of *E*. The disposition of the light rays is such that ordinarily the plate *E* cuts off all the light from *A*, but as soon as the telephone diafram vibrates the plate *E*, more or less light is made to pass thru the latter, which light in turn is stopt by the revolving plate *G*; the latter has the same helical perforations as the disc *B* at the sending station. Theoretically therefore, the picture in motion should be formed in the camera at the receiving end, and this picture should correspond with the one sent out from the sender. This picture would then be thrown on the screen of the receiving station as shown. It goes without saying that the two revolving discs *must work in synchrony*. It is also necessary that the discs be revolved *once in one-tenth of a second*, which is just the average time of the persistence of the luminous images on the retina of the human eye, and which is supposed to build up the transmitter picture, and in turn is observed on the screen. The lens *F* at the receiving end is used merely to enlarge the picture.

(*To be concluded.*)

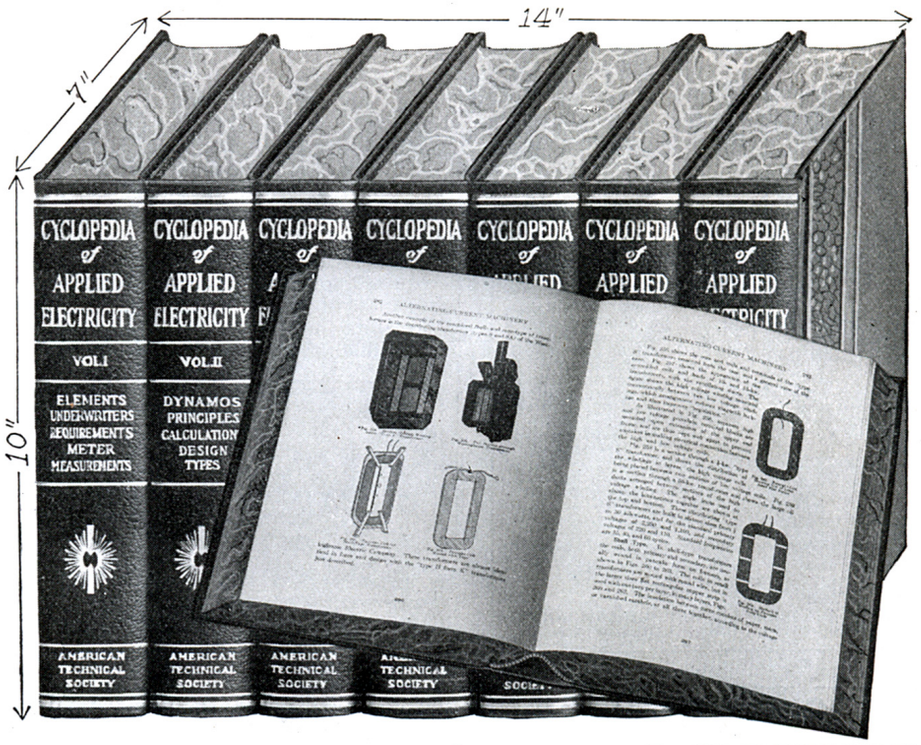
A NEW PHONOGRAPHIC "LOUD TALKER" FOR PUBLIC PLACES.

(*Continued from page* 15)

phone attached to the "Cortlandt Street" reproducer, thence thru the lamp ballast, which is usual with the 110-volt loud-speaking telephone equipment now used extensively, and so on around thru the one or more multiple circuits of the loud-talking reproducers, which are fitted with horns as illustrated.

We can easily picture just how this arrangement would work out. Let us imagine for a moment that we are passing thru the under-river tube toward New York, after having left the Pennsylvania Railroad Station in Jersey City. It would be optional, of course, as to whether the guard pushed the "Cortlandt Street" loud-talker push button, and announced the next stop as "CORTLANDT STREET—NEW YORK —ALL OUT" directly after leaving the Pennsylvania Railroad Station stop, or whether she would depress this push button shortly before arriving at the "Cortlandt Street" stop. This, of course, would be a matter for the traffic engineers of the railroad system adopting the device to work out to their own satisfaction.

The action of the apparatus is very simple, and it will be noted by referring to the diagram herewith that when the phonograph reproducer has reached the end of its record that it would be automatically tript up and returned to its original position in the same manner as the penny-in-the-slot automatic phonographs we are accustomed to in public amusement places. Also, when the microphone and reproducer unit have been returned to the starting position, the same mechanism would cause a traveling switch contact to close a magnetic cut-off circuit, which would trip the magnetic switch when its moving core and attached contacts would at once return to their original position by gravity.



SEND NO MONEY

USE THESE ELECTRICAL BOOKS SEVEN DAYS AT OUR EXPENSE

By merely filling in and mailing the coupon below you can get this complete set of the Cyclopedia of Applied Electricity *on trial.* Pay only small shipping charges when they arrive. Use these books for seven full days before you make up your mind whether or not you want them. If you keep them, you may pay the special advertising price in easy instalments of $2.00 a month. If you don't want them, you may send them back at our expense and you won't be out a penny.

A MASSIVE ELECTRICAL LIBRARY—NOT HANDBOOKS

These seven splendid volumes contain all the knowledge you need in order to earn big money in the electrical field. They are not thin handbooks, but thick, encyclopedia-size volumes, handsomely bound in half morocco leather, gold stamped. Each one measures 7 by 10 inches, and is 2 inches thick.

This big size permits the use of large and comprehensive illustrations, plates, diagrams, etc. Over 3,000 cuts are contained in the Cyclopedia's 3,500 pages.

The completeness of the Cyclopedia will be a revelation to you. Everything electrical is explained in plain, simple English—every technical point is made clear. Each volume is carefully cross-indexed for instant reference.

Read These Subjects
Elements of Electricity—Electrical Measurements—Underwriters' Requirements—Theory. Calculation, Design and Construction of Generators and Motors — Dynamo-Electric Machinery—Lighting Machinery—Power Transmission—Electric Railways—Power Stations — Switchboards and Switching — Storage Batteries—Applied Electro-Chemistry — Electric Elevators—Electric Welding and Heating — Wire and Wireless Telegraphy.

50c a Week **For this sum—an insignificant one — this wealth of electrical information is yours. But you don't have to send us a penny until you have used the books for seven days. Then, if you decide to keep them, send only $2.00 a month—*50c a week*—until the special advertising price of $19.80 has been paid. The regular price of these pay-raising books is $35.00.**

Consulting Service Free

A year's Consulting Membership in the American Technical Society—regular price $12.00—will be included with all orders for a limited time. The advice of an entire corps of electrical experts is yours to help you in your progress—for a whole year FREE!

Send No Money—Just the Coupon

See these books for yourself before you buy. Remember, you don't risk a penny or assume a single obligation. The books will be sent to any one within the boundaries of the United States or Canada, and they may be returned at our expense if they fail to please. But you must act now! This generous offer cannot be continued indefinitely. Send the coupon now.

AMERICAN TECHNICAL SOCIETY
Dept. E-7445 CHICAGO, U.S.A.

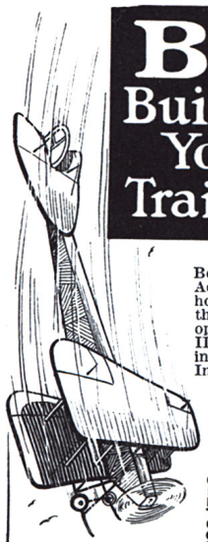
American Technical Society
Dept. E-7445 Chicago, U.S.A.

Please send me the Cyclopedia of Applied Electricity for seven days' examination. I will pay net shipping charges. If I decide to buy, I will send you $2.00 in seven days, and the balance at the rate of $2.00 a month, until $19.80 has been paid. Then you will send me a receipt showing that the set of books and the $12.00 consulting membership are mine and fully paid for. If I think that I can get along without the books, I will return them after seven days, at your expense.

Name.....

Address.....

Reference.....



BOYS
Build and Fly Your Own Training Plane

Train yourself in Aviation. Be an Amateur Aviator with an Aeroplane of your own. Learn how Aeroplanes are built; learn the principles of construction, operation and control. With IDEAL Accurate Scale Drawings, and Building and Flying Instructions, you can build a perfect Model Aeroplane, 3 ft. size, that will rise from the ground by its own power and fly like a big one. Send now for the Plans for the one you want to build.

Drawings and Instructions for
Curtiss Military Tractor
Bleriot Monoplane
Nieuport Monoplane
Taube Monoplane
Curtiss Hydroplane
Curtiss Flying Boat
Wright Biplane
Cecil Peoli Racer

25c Each (8 for $1.75)

Send for Our Aeroplane Catalog

Tells about Model Aeroplanes, Racing Aeroplanes, Flying Toys, and parts and supplies to build them with. 48 pages. Send 5 cents for it today.

IDEAL AEROPLANE & SUPPLY COMPANY
76-82 West Broadway New York City

WAR CONDITIONS DEMAND ELECTRICAL ENGINEERING

men with training. Having trained over 2000 young men, The Bliss Electrical School, with its well-equipped shops and laboratories, is peculiarly qualified to give a condensed course in Electrical with Mathematics, Steam and Gas Engines, Mechanical Drawing, Shop Work, and Theoretical and Practical Electricity. Students construct dynamos, install wiring and test electrical machinery. Course, with diploma, complete

IN ONE YEAR

For practical young men with limited time. 26th year opens Sept. 25th. Catalogue on request.
260 TAKOMA AVENUE WASHINGTON, D. C.

WIRELESS or MORSE

Complete afternoon and evening courses

Improved teaching facilities recently installed. Radio under general supervision of E. E. Bucher, Instructing Engineer Marconi Co.

Employment bureau—dormitories — individual instruction.

Send for folder G on land wire—R for radio.

Y. M. C. A. TELEGRAPH SCHOOL
Marcy Av., near B'way, Brooklyn, N.Y.

LEARN DRAFTSMANSHIP

Send for free Test lesson and valuable information on Draftsmanship. Learn how you can master it at home at leisure time. Easy terms. Unusual opportunities now due to make Draftsmen earn $25 to $100 a week. Write today.

LESSON FREE

CHICAGO TECHNICAL COLLEGE
545 Chicago "Tech" Bldg. Chicago

SMALL ENGINES

Perfected Gasoline Engines—½, 1 and 1½ h.p.—for Farm and Shop use. Price $19.50 and up. Also

WASHING MACHINES

We ship on trial. Send for Booklet and Special Offer
Sieverkropp Engine Co., 1401 19th Street Racine, Wis. *Starter for Ford Cars*

BIG PAY Men and Women

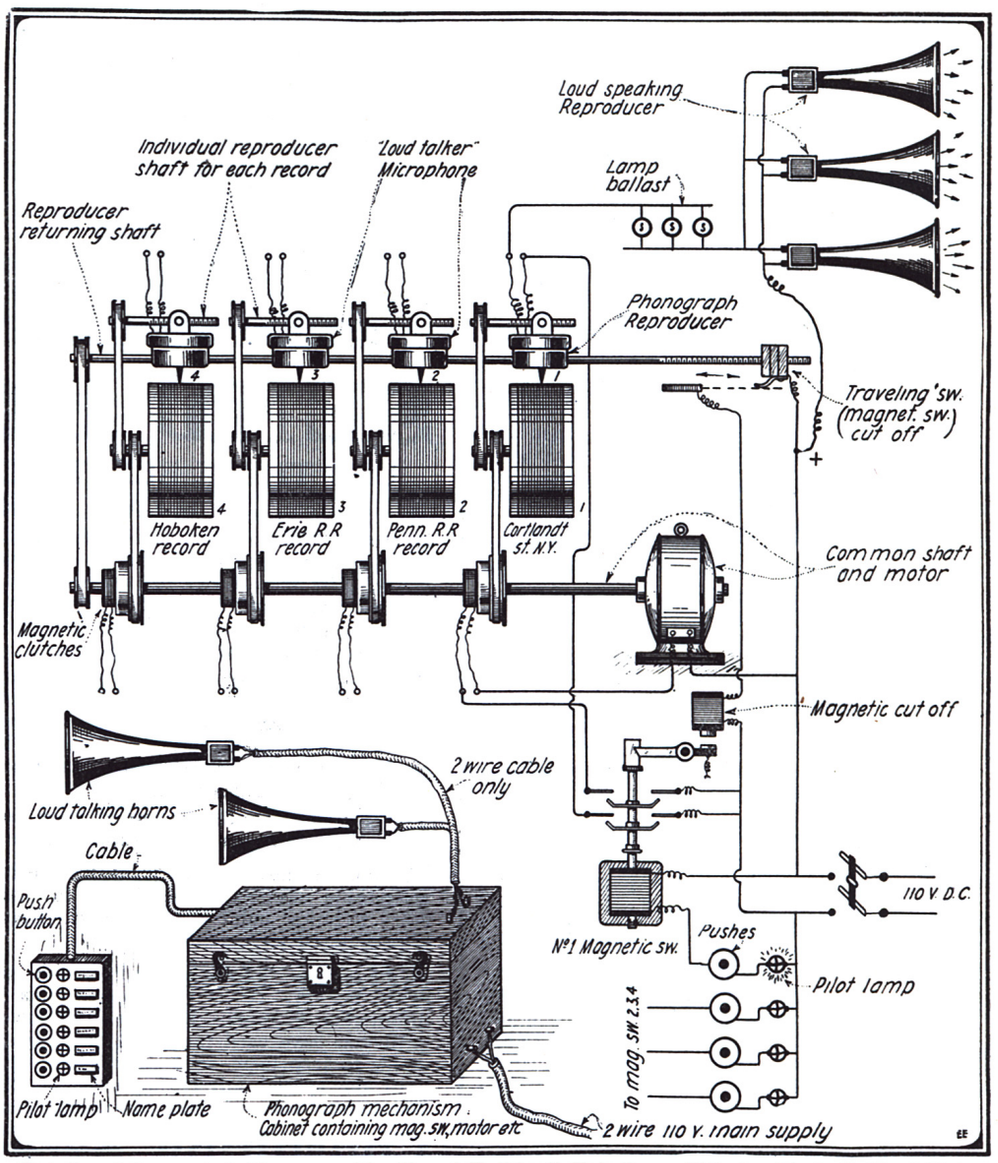
Earn $100 to $200 a month. Tremendous demand for draftsmen. Pleasant work. We furnish drawing outfit FREE; train you at home in spare time and help you secure position when qualified. Write today for full particulars *Special offer to men subject to draft.*

COLUMBIA SCHOOL OF DRAFTING
428 McLachlen Building Washington, D. C.

Regarding the arrangement of the loud-talking reproducers, these could very well be placed along the ceiling of the car or they could be placed on the side of the car, spaced alternately on both sides, so as to give the best distribution of the sound waves. So far as the equipment itself is concerned, the phonograph attachment and its auxiliary mechanisms, including the electric driving motor of small size, magnetic switches, etc., could all be placed in a small cabinet which would readily fit under one of the seats. A two-wire cable only is required to connect the phonograph mechanism with the loud-talking reproducers. To some it might seem that all of the individual records might be combined into one phonograph cylinder, thus utilizing but one reproducer and microphone, but it seems to the writer that it would be a much simpler and more economical arrangement to use the individual records for each call, excepting where there might be a very large number of stops or individual announcements to be made. This is so for one reason, and that is in the event that a record should crack or be broken; then it would be a very simple and economical matter to replace one of the short phonograph records.

The accompanying illustrations show several practical applications of the phonographic loud-talker. The first illustration shows the outfit in use in subway or elevated trains for announcing the station "stops," so that we may not have to be tortured many more years with frog-throated announcements of our subway and "L" train guards, which generally sound like a cross between a French artillery barrage and an advance of one of General Byng's tank squadrons.

The phonographic loud-talker would find a wide application in theaters and other public places, and in theaters it would for one thing seem very advisable for the purpose of giving "fire exit" warnings before the start of a show, and also for making the announcements of future plays between acts, etc. The loud-speaking telephone itself has been successfully used in push-



Details of Suggested Phonographic "Loud-Talking" Telephone Fitted with Individual Voice Records for Each Stop—in this Instance for the Four Stops Made by Hudson Tube Trains in Running from New York City to Hoboken, N. J. The Loud-Talking Telephone is Now a Commercial Success and Needs but to be Applied to Our Daily Wants.

The new form of this apparatus would also be very appropriate for use on steamboats, particularly those making trips along inland water-ways, as, for instance, on the Hudson River, Delaware River, Mississippi, etc. The writer has traveled on a number of the eastern river boats and remem-

bers distinctly that a great many of the passengers have been at a loss to know just what landing the boat was approaching, especially where there are strangers who are not familiar with the country thru which they are traveling. With the new phonographic loud-talker, the officers of the boat could simply throw a switch or push a button in the captain's cabin, and the loud-talking reproducers distributed thruout the various decks of the steamboat would do the rest. Not only this, but in the event of "fire" and other trouble, the loud-talkers could be switched over by means of a simple switch arrangement, so that one of the officers could announce the danger and tell the passengers where to find the life preservers, etc., etc.

The phonographic loud-talker, or also the loud-talker without the phonograph, would appear to have a wide field of usefulness in the extensive trench and dug-out ramifications existing on the European battlefields. We can imagine how useful these would be if installed in underground dug-outs for instance, so that, in the event of a gas attack, the officers, or in fact any one discovering that a gas attack had been made, could at once give the alarm thru the loud-talking telephones, when the occupants of the dug-outs could immediately put on their gas masks. This application may not seem so desirable at first thought by the layman, but it will probably be recollected by the reader that the current press accounts of the recent gas attacks by the Germans have distinctly indicated that it often happens that the gas attacks are made and that soldiers do not know it for some time, probably when it is too late, for the simple reason that some of these gases do not have any odor and they thus defy detection by smell. With proper gas-detecting apparatus and with the equipment here outlined, it should prove another step in advance toward saving the lives of many of our soldiers.

The phonographic loud-speaking telephone should find wide favor in the large department stores and other similar buildings having various departments which have to be announced by the elevator attachés. Instead of having, as is now the case, particularly, to rely on a lady elevator attaché calling out the various departments at each floor, imagine how much simpler and more satisfactory would be the announcement as made by the phonograph thru the loud-talking attachment, which could be installed very easily in the elevator cab. Possibly, in the not distant future, we may hear the stentorian tones of the phonograph announcing: "THIRD FLOOR—'WHITE' SALE TODAY—MUSLINS, POWDERED SUGAR, HOSIERY, CAMPHOR BALLS, UNDERWEAR—WHITE-WASH," et cetera, in clear and easily understandable tones.

NEWS OF BUENOS AIRES-NEW YORK RADIO.

(*Continued from page 27.*)

said station had a power of 65 kw., and a wave-length of 2,500 meters.

At the last moment I have been informed, that the Government has authorized the transference of the concession granted in September, 1915, to the Federal Holding Co., of New York, for the construction of a high-power station to communicate directly from Buenos Aires to New York, to the Pan American Wireless Telegraph and Telephone Co., which has been formed by the combination of the Federal Holding Co., and Marconi's Wireless Telegraph Company of America and the Federal Telegraph Co., of San Francisco. The work on this station will begin this May.

Make this car your office—

there is $900.00 to $1800.00 a year in it for you

Examinations everywhere soon

Rapid advancement to higher Government Positions. "No layoffs" because of STRIKES, FINANCIAL FLURRIES or the WHIMS OF SOME PETTY BOSS. THE POSITION IS YOURS FOR LIFE.
Country residents and city residents stand the same chance for immediate appointment. Common-sense education sufficient. Political influence NOT REQUIRED.

We will prepare 25 Candidates FREE! Write immediately for schedule showing the places and dates of all coming Gov't examinations. Don't delay.

Every day you lose means the loss of just so much coaching before the rapidly approaching examinations.

FRANKLIN INSTITUTE
Dept. O102, Rochester, N. Y.

Government Wants Thousands Men --Women Clerks for War Work

COUPON

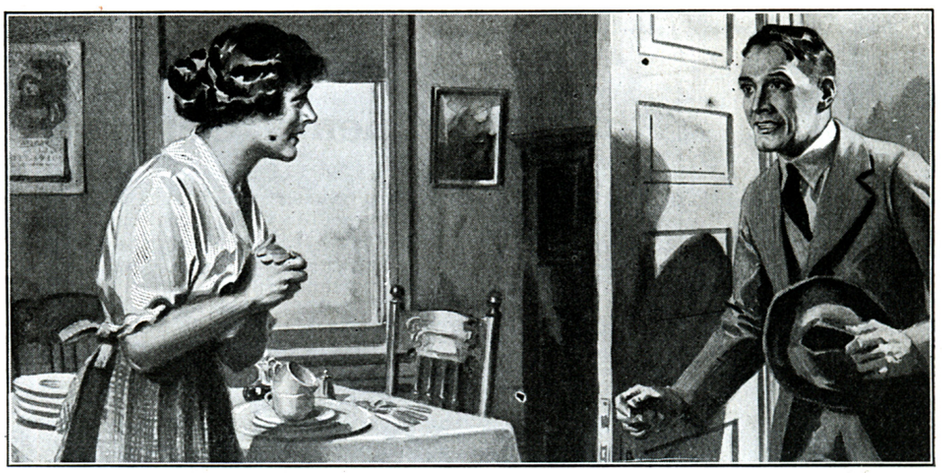
FRANKLIN INSTITUTE (The pathway to plenty), Dept. O 102, Rochester, N.Y.

This coupon, filled out as directed, entitles the sender to (1) free specimen questions, (2) a free copy of our copyrighted book, "Government Positions and How to Get Them," (3) a list of positions now open, and (4) to consideration for Free Coaching for the examination here checked.

...Railway Mail Clerk.. ($900 to $1800)
...Postoffice Clerk. ($800 to $1200)
...Postoffice Carrier. ($800 to $1200)
...Rural Mail Carrier. ($600 to $1100)
...Customs Positions. ($800 to $1500)
...Stenographer.... ($1100 to $1800)
...Clerk in the Departments at Washington... ($1100 to $1800)

Name..... Address .....

Use this before you lose it. Write plainly.



"I Got the Job!"

"I'm to be Manager of my Department starting Monday. The boss said he had been watching all the men. When he found I had been studying at home with the International Correspondence Schools he knew I had the right stuff in me—that I was bound to make good. Now we can move over to that house on Oakland Avenue and you can have a maid and take things easy. I tell you, Nell, taking that course with the I. C. S. was the best thing I ever did."

Spare-time study with the I. C. S. is winning promotions for thousands of men and bringing happiness to thousands of homes all over the world. In offices, shops, stores, mines, mills and on railroads, I. C. S. trained men are stepping up to big jobs, over the heads of older men, past those whose only qualification is long service.

There is a job ahead of *you* that some man is going to be picked for. The boss can't take chances. When he selects the one to hold it he is going to choose a trained man with sound, practical knowledge of the work. Get busy right now and put yourself in line for that promotion. You can do it in spare time in your own home through the International Correspondence Schools, just as nearly two million men have done in the last twenty-five years, just as more than 100,000 men are doing today.

The first step these men took was to mark and mail this coupon. Make *your* start the same way—and make it right now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 5381, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BOOKKEEPER
☐ MECHANICAL ENGINEER	☐ Stenographer and Typist
☐ Mechanical Draftsman	☐ Cert. Pub. Accountant
☐ Ship Draftsman	☐ Traffic Management
☐ Machine Shop Practice	☐ Commercial Law
☐ Gas Engineer	☐ GOOD ENGLISH
☐ CIVIL ENGINEER	☐ Common School Subjects
☐ Surveying and Mapping	☐ CIVIL SERVICE
☐ MINE FOREM'N OR ENG'R	☐ Railway Mail Clerk
☐ STATIONARY ENGINEER	☐ Textile Overseer or Supt.
☐ ARCHITECT	☐ AGRICULTURE ☐ Spanish
☐ Architectural Draftsman	☐ Navigator ☐ on phonograph disks
☐ PLUMBING AND HEATING	☐ Poultry Raising ☐ French
☐ Sheet Metal Worker	☐ Automobiles

Name_____

Present Occupation_____

Street and No._____

City_____ State_____

Violet Rays For Home Use

Wonderful HEALTH and BEAUTY GIVER

Electricity from your light socket transformed into the greatest health-giving agency known to Science—VIOLET RAY—powerfully effective, yet soothing and gentle in action. Benefits of tremendous voltage of electricity absorbed by the human body without the slightest shock, muscular contraction or pain of any kind; pleasant and perfectly safe.

RenuLife Violet Ray

High Frequency Generator

Used and endorsed by physicians and beauty specialists; saturates the body with soothing, invigorating, curative violet rays, producing New Life, Power and Beauty; purifies the blood stream and brings the circulation to parts treated, renews and builds up.

Every home should have this marvelous invention; benefits every person in sickness or health; smallest infant, aged or feeble. **It is not a cure all**—but treats successfully a wide range ailments because it is systematic in effect—relieves the symptoms while steadily removing the cause; bringing back normal conditions.

LOWEST PRICE

This is the lowest priced, most effective instrument of its kind in the world, *guaranteed*. Price so low that no family can afford to be without it.

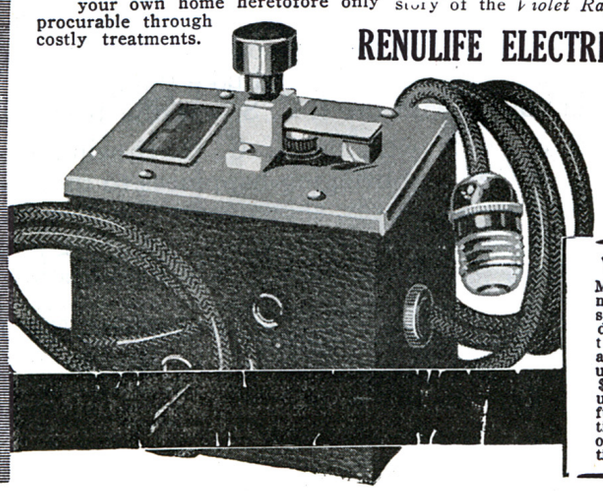
Use At Home

You can receive the benefits in the privacy of your own home heretofore only procurable through costly treatments.

Get Book "Health" FREE

Send for our booklet "Health" telling in detail the wonderful story of the *Violet Ray*—

RENULIFE ELECTRIC CO.,
534 Marquette Bldg.
Detroit, Mich.



Treat Successfully

Rheumatism
Neuritis
Lumbago
Chest Pains
Catarrh
Headache
Ear Diseases
Hardening of Arteries
Wrinkles
Skin Diseases
Falling Hair
Etc. Etc.

Treatment Chart furnished showing use for over 100 ailments.

WANTED

Men and women representatives to demonstrate to doctors and individuals. Earn $50.00 a week up. We give full instructions. Get our proposition.

EXPERIMENTAL CHEMISTRY.

(*Continued from page 42*)

by heating ammonium nitrat, and when the gas is escaping and free from air (a condition essential to success), pass it up into the other bottle of *nitrogen dioxid*. It will be noticed that there is no action, barring a slight red fume due to a very little oxygen, with the nitrogen monoxid, whereas oxygen combines with nitrogen dioxid to form nitrogen tetroxid, which is at once dissolved in the water. Carefully study this distinction.

Nitrogen Dioxid.

Preparation:

1. Nitrogen dioxid is commonly prepared by the action of nitric acid on copper, tho many other metals act similarly. The acid should be diluted.

$$3Cu + 8HNO_3 = 3Cu(NO_3)_2 + 4H_2O + N_2O_2$$

2. By the action of a ferrous salt upon nitric acid or a nitrat in the presence of sulfuric or hydrochloric acid.

$$6FeSO_4 + 2KNO_3 + 5H_2SO_4 = 3Fe_2(SO_4)_3 + 2KHSO_4 + 4H_2O + N_2O_2$$

$$6FeCl_2 + 2KNO_3 + 8HCl = 6FeCl_3 + 2KCl + 4H_2O + N_2O_2$$

The proportions for the above reaction are 30 grams of potassium nitrat, 240 grams of ferrous sulfate, and 250 cc. of a mixture of one volume concentrated sulfuric acid and three volumes of water. A colorless gas escapes, which, however, forms brown vapors as it comes in contact with the air; but as soon as all the air has been driven from the apparatus it passes off colorless and may be then collected over water.

3. By adding sulfuric acid slowly to a mixture of a saturated solution of sodium nitrat and copper turnings.

$$8NaNO_3 + 4H_2SO_4 + 3Cu = 4Na_2SO_4 + 3Cu(NO_3)_2 + 4H_2O + N_2O_2$$

Properties: (Physical) Nitrogen dioxid is a colorless gas.

It dissolves readily in solutions of ferrous salts, forming a black-colored solution, from which it is expelled upon heating. It is upon the formation of this coloration that the test for nitric acid or nitrates is based.

(Chemical) Nitrogen dioxid only sustains the combustion of such substances whose heat liberated is sufficiently high to to cause it to break down into nitrogen and oxygen. Carbon bisulfid (a highly inflammable liquid) and phosphorus burn brilliantly in the gas, the former forming carbon dioxid and sulfur dioxid.

EXPERIMENT NO. 126. Nitrogen Dioxid from Copper and Nitric Acid.

Have a 250 cc., Erlenmyer flask of thick glass and corrugated side neck, and a one-hole rubber stopper carrying a thistle tube; or, use a wide-mouth bottle, with a rubber stopper having two holes, one for the delivery tube, (if the flask with side-neck is used, the delivery tube is connected to this sideneck). Put into the generator 10 grams of copper scraps, and add 20 cc. of water, or enough to cover it. Prepare the tray or trough with inverted receivers (8 ounce bottles) filled with water as described in the lesson on Oxygen. After adjustment pour in 20 cc. of nitric acid. A little of the gas should first be rejected, as it is largely mixed with air. If presently the action is not vigorous, add more acid. Notice and observe carefully all phenomena.

After collecting four receivers of the gas to be tested in the following experiment, fill the generator with water, rinse the remaining copper several times, and then put it back into a receptacle.

EXPERIMENT NO. 127. Tests and Properties. The Oxygen Test.

Lift one of the receivers from the trough and hold it upright, noting color, odor, diffusibility. Do you recall having seen the product before?

EXPERIMENT NO. 128.

COMBUSTION TEST.

Remove one of the receivers with a glass plate, keeping it covered except as tested.

Radium and Radioactive Substances FOR EXPERIMENTERS

Carnotite

Carnotite (Radium Mineral) The American Pitchblende found in Colorado, from which *Radium* is extracted.
A generous piece, enough to conduct experiments, such as affecting photographic plates thru opaque material (similar to X-Ray pictures), first made by Sir W. Crookes and Mme. Curie, is furnished in neat wooden box.
Sensitive, prepared Photographic film (X-Ray work film) to be used for above experiments furnished for $0.10 each extra.

Radium— Radioactive Salts, containing one microgram pure Radium. Very powerful. Brilliant white luminescence in the dark!
10 Milligram of this most carefully prepared Radioactive Salts, sealed in glass tube (protected by a metal container), with which every Radium experiment can be conducted, are furnished.
Price of one tube of Radium Salts as described, sent prepaid $1.00
The contents of this tube can be mixed with special sulphides to form real *Radium paint*.
Small bottle of Special Sulphide with liquid adhesive, prepaid $0.50
Send for one of these preparations today. Stamps or coin accepted.
SIDNEY SPECIALTY CO. 233 S. FULTON ST. NEW YORK CITY

Thrust into it a burning splint, and notice results. Try it several times to make sure.

Try another jar of the gas with burning phosphorous, using a piece the size of a split pea, first having it burning vigorously or the experiment will not succeed. *Remember to burn all the phosphorous at the end.* On taking out the combustion cup keep the jar covered in order to examine the fumes.

If the phosphorous burned, observe the color of the flame and the product. How many sorts of fumes can you distinguish? From these tests do you conclude the Nitrogen is a supporter or a non-supporter of combustion? Do you conclude it is combustible or non-combustible? Is it an oxidizer or a reducer? How would you distinguish the gas from all other gases?

Leave one bottle of the gas standing on the shelf (if the trough is used), then prepare an oxygen generator (the test tube with potassium chlorat and manganese dioxid will suffice. (See lesson on Oxygen) and pass some of the oxygen up into the bottle filled with *nitrogen dioxid.* Note the result and continue the process for some time.

Try and explain why you do not obtain the familiar red fumes. What property of the gas is shown by this experiment?

Finally take out the bottle with the water and set it upright; then test it with litmus. What does this test show? Is it likely or not that the oxid has combined with the water? If so, try and determine by employing equations what has formed.

NITROGEN TRIOXID.

PREPARATION:—

This gas, known only at low temperature, is formed thru the union of nitrogen dioxid (4 vols.) With oxygen (1 vol.) at —18 deg. $4\,NO+O_2=2N_2O_3$. When a 50 per cent nitric acid is heated with starch, orange-red fumes are evolved which consist of a mixture of nitrogen trioxid and tetroxid. On passing these vapors into a vessel surrounded by a freezing mixture, they form a green liquid. Pure trioxid at —10 deg. is an indigo-blue liquid. Above —12 deg. the liquid begins to decompose: $2N_2O_3=N_2O_4+N_2O_2$. With a small quantity of water nitrogen trioxid forms nitrous acid; $N_2O_3+H_2O=2HNO_2$: With a large quantity of water decomposition takes place and nitric acid results: $3N_2O_3+H_2O=2HNO_3+2N_2O_2$.

Nitrogen trioxid and nitrogen peroxid are red-brown gases, indistinguishable from each other except by *volumetric analysis,* their chemical characters being nearly identical. **THEY ARE VERY SUFFOCATING, INTENSELY POISONOUS AND STRONG AGENTS.**

NITROGEN TETROXID OR PEROXID.

PREPARATION:—

Nitrogen tetroxid is prepared by:

1. Thru the union of nitrogen dioxid and oxygen. $N_2O_2+O_2=N_2O_4$.

2. Heating lead nitrat: $2Pb(NO_3)_2=2PbO+O_2+2N_2O_4$.

The gas may be liquefied by passing into a U-tube cooled by ice and salt.

PROPERTIES:—

Nitrogen Tetroxid is a dark gas which is readily cooled to a light yellow fluid.

With a little cold water, nitrogen tetroxid forms nitrogen dioxid and nitric acid, with an excess, as also aqueous solutions of alkalies, nitric, and nitrous acid or their salts are produced.

$NO_2—O\text{-}NO+HOH=NO_2OH+NO.OH$

$3NO_2+HOH=2NO_2NO_2OH+NO$

EXPERIMENT NO. 129.

NITROGEN TETROXID FROM NITRATES.

Put into a small test tube four or five crystals or grains of lead nitrat. Hold the tube in the left hand with a tube holder and point it toward the right, keeping the lower part of the tube in the hot part of the Bunsen burner, and, having a glowing splint in the right hand, thrust it into the tube near the bottom as soon as vigorous action begins. This test is merely to show that oxygen is also liberated, together with the oxid. Repeat the operation several times.

Notice the sound when the crystals are heated. Note the color of the fumes and their odor.

Not all nitrates break up by the application of heat; for instance, sodium or potassium nitrat will not, and ammonium nitrat gives a different result, as you have already found.

EXPERIMENT NO. 130.

FROM NITRIC ACID.

Most metals heated with nitric acid give NO_2, either as a secondary product by the union of oxygen of the air with the dioxid or directly. Test the action of the acid on tin-foil in small pieces, heating it if necessary.

$3Sn+4HNO_3+H_2O=3H_2SnO_3+4NO$

What kind of a substance is left? It is called *Metastannic Acid.*

EXPERIMENT NO. 131.

Put about a gram of fine charcoal in a test tube, heat it till it glows, then let fall two or three drops of strong nitric acid from another tube. Note any phenomena. Heated starch or other carbonaceous substance acts in a similar manner. When nitric acid or a nitrat breaks up the usual immediate reduction product is NO, but in case any oxygen is present either from the air or from the product itself, the affinity of the two is so great that combination at once occurs. Occasionally the secondary action of reduction does not give NO or NO_2, but free nitrogen or even ammonia. (NH_3).

EXPERIMENT NO. 132.

NITROGEN TETROXID, COMPOSITION.

From Nitrogen Dioxid and Oxygen.

Invert a 50 cc. cylinder graduate filled with water in a trough and clamp it in position so as to collect 40 cc. of gas in it.

With a nitrogen dioxid generator (using Cu and HNO_3) collect in the graduate 40 cc. of the dioxid, taking care to expel all air from the generator before allowing any gas to collect, and noting exactly the volume of NO.

Arrange *in another trough* a second graduate which may, if desired, be smaller than the first, inverted and clamped so as to collect 20 cc. of gas. Prepare an oxygen generator (employing potassium chlorat and manganese dioxid), and when all the air has been expelled and oxygen is liberated freely, collect 20 cc. of oxygen in the last graduate, that is, half as much as of NO. Set aside both generators.

Now transfer the graduate containing the dioxid to the other trough and clamp it in position. This is done by sliding the mouth of the graduate into an evaporating dish half filled with water. No air must be admitted. The reason for the transfer is that when NO is generated about 10 per cent will dissolve in the water in the trough, and it absorbs much oxygen as the latter is poured upward.

Next unclamp the oxygen graduate and carefully pour the contents in successive portions up into the graduate containing NO. An inverted funnel may be used if necessary.

If the experiment is made with sufficient accuracy, the graduate should be completely filled with water at the end. If it was not in your case, can you see any reason?

Record your results as follows:—

Volume of NO collected (v).....cc

Volume of O introduced (v/2).....cc

Ratio of volume of NO to 0 (v:½ v)....

Symbol of Nitrogen tetroxid.....

(To be continued.)

Better Yourself

STRONGFORT
The Perfect Man

By all means. Why handicap your effort? You are not half what you want to be—not half what you really ought to be. No matter who you are, what you are—what your condition is, or how capable you are, you can be superior to what you are.

I can make you wonder at the change in yourself. It is not what you were at one time, it is what you are today that counts—what you will be is up to you. No matter what your position or condition may be, you can, through Strongfortism, practically rebuild yourself from toe to top—make your brain more active, your will power stronger, your memory better; you can increase your capacity and double your vitality.

No need for you to be listless, dull and logy; no reason for you to feel languid, indolent and always out of sorts. Sometimes errors are committed in youth that reflect upon success. There are pupils of Strongfortism everywhere building themselves up in every way, and some who were physical wrecks, are now men in every sense of the word. You can be free from your ailments, from disorders that make you unfit. Under Strongfortism, you will grow in physical, mental and moral force; you stimulate ambitious desires that urge to success; no matter what ailment you now have, your system will be revitalized and your disorder cease. If you have indulged in excesses or pernicious habits, that have left you weakened and debilitated,

STRONGFORTISM

Will Vitalize You

Disease in any part of your body is due to lack of vital resistance. Strongfortism will give you vital resistance, dissipate any disorder or ailment you have and restore your failing powers. You are not normal now; Strongfortism will make you normal, splendidly so. No false stimulation from drugs, tonics, medicines of any sort—your whole body will be rebuilt, your blood made rich, your nerves nourished, your physical and mental ability improved and your efficiency increased doubly and trebly. You will be strong, virile and actively aggressive, and a more dominant factor in your circle. You will overcome your passive submission and be alive to the possibilities that surround you.

Send 6 cents in stamps to cover mai ing expenses and receive my book "PROMOTION AND CONSERVATION OF HEALTH, STRENGTH AND MENTAL ENERGY." Check off your principal ailment or disorder on the coupon. Send it in and receive the book free with valuable information.

LIONEL STRONGFORT
Physical and Health Specialist
490 Park Building, Newark, N. J.

Personal Consultation by Appointment only

CUT OUT AND MAIL THIS COUPON

Mr. Lionel Strongfort, Newark, N. J.
Sir: You may forward your book, **"Promotion and Conservation of Health, Strength and Mental Energy."**
I enclose 6 cents in stamps for mailing expenses. I marked X before the subject on which I would like a practical talk. (490)

..Colds	..Flat Chest	..Poor Memory
..Catarrh	..Deformity	..Rheumatism
..Asthma	..Insomnia	..Vital Losses
..Obesity	..Impotency	..Heartweakness
..Headache	..ShortWind	..Poor Circulation
..Thinness	..Flat Feet	..Skin Disorders
..Rupture	..Constipation	..Despondency
..Muscular Development	..Biliousness	..Round Shoulders
	..Torpid Liver	..Lung Troubles
..Neuritis	..Indigestion	..Increased Height
..Neuralgia	..Nervousness	..Youthful-Errors

Name .....

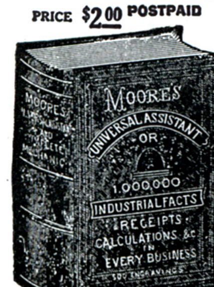
Address .....

Moore's Universal Assistant and Complete Mechanic

CONTAINS 1016 PAGES, 500 ENGRAVINGS, AND OVER 1,000,000 INDUSTRIAL FACTS, CALCULATIONS, RECEIPTS, PROCESSES, TRADE SECRETS, FOR EVERY BUSINESS!

FOR STERLING VALUE, ELEGANCE, AND LOW COST, THIS WORK HAS NO COMPEER IN THE ENGLISH LANGUAGE.

PRICE $2.00 POSTPAID



The Work contains 200,000 items for Gas, Steam, Civil and Mining Engineers, Machinists, Iron Founders, Plumbers, Metallurgists, Assayers, Miners, Builders, Metal and Wood Workers, Manufacturers, etc. Full details (with 500 Engravings) for constructing, operating, and Repairing Mill and Steam Machinery of every kind, setting of Valves, Link and Valve Motion, Eccentrics, Indicator Diagrams, Injectors, Steam Boilers, Gauges, Machinists' Tools, Mechanical Movements, Tunneling, Mining and Rock Drilling Machinery, Wheel Gearing, Gas Meters, Diagrams for Sheet Metal Workers, Views of Noted Buildings, Bridges, Plans of Mills, etc.

FULL INSTRUCTIONS TO ENGINEERS, FIREMEN, BOILER MAKERS, ENGINE AND CAR BUILDERS, ETC. Proportion of Engines, Repairing Locomotive Break-Downs on the Road, Boiler and Steam Pipe Covering, Cements—69 kinds, Bright Polish—4 kinds, Scale Preventives—10 kinds, to Clean Waste, Details for Cotton, Woolen, and Fulling Mill Machinery; ditto, for Flour, Oatmeal, Saw, Shingle, Planing, Paper and Wind Mills, Grain Elevators, Sugar, Oil, Marble and Rolling Mills, Blast Furnaces, Gas Works, Water Works, Mill Dams, Water Wheels, Hydraulics, Cotton Presses, Speed of Wheels, Pulleys, Drums, Circular Saws, Woodworking Machinery, Horse Power of Streams, Belts, Strength of Metals, Timber, Building Materials, etc. Seasoning of Timber—12 ways, Growth of Forest Trees, Logging, Cost of Supplies, Stream Driving, Lumber Measurement and Surveyors' Tables, full and complete. Views of Lumbering Scenes, Saw Mills, Saw Filing, 13 Engravings. Carpentry, with Diagrams of Roofs, Tonnage Tables, Proportion of Stowage in Ships, Solid Contents of Boxes, Bales, Stones, Barrels, Timbers, etc.

500 Processes, Tables and Engravings for WATCH-MAKERS, JEWELERS, GILDERS, PLATERS, COLORERS, GOLD BEATERS, SILVERSMITHS, OPTICIANS, LAPIDARIES, DIAMOND CUTTERS, ENAMELERS. Watch Repairing, full details. 800 Items, Estimates, Tables, etc., for Printers and Publishers, Correcting Proofs, Bronze and Gold Printing, Inks, Hardening Glosses, Driers, etc. Calculations for Gas Companies, etc. 500 Receipts for FRESCO, HOUSE, SIGN, CARRIAGE AND ORNAMENTAL PAINTERS, GRAINERS, CARVERS, POLISHERS, GILDERS, CABINET MAKERS, PIANO, ORGAN, AND PICTURE FRAME MANUFACTURERS. Glass Gilding—5 ways, Wood Filling—12 kinds, Polish—17 kinds, Stains for Wood—54 kinds, to Clean Pictures, to Restore Old Paintings.

ESTIMATES, TABLES, PROCESSES, ETC., FOR MASONS, CONTRACTORS, PLASTERERS, ROOFERS, STUCCO WORKERS. 800 Reliable Remedies for Physicians, Druggists, Families; on Bathing, Maintenance of Health, Rules for Emergencies, etc. 10,000 Items for FARMERS, Land, Grain, Hay and Cattle Measurements, Fencing, Ploughing, Planting, Seed, and Breeding Tables, Contents of Granaries, Corn-cribs, etc., at sight, Food Values, to Secure Large Crops, Kill Farm Pests, Renew Orchards, 16 Powerful Fertilizers, Horse and Cattle Remedies, Rotation of Crops, to Brake, Train and Shoe Horses, Compound Food for Stock, Steam Power on Farms, Rural Economy; on Bees and Bee-keeping, illustrated, Construction of Hives, Plans for Barns, etc., Butter and Cheese Making, Soiling Stock, etc. 380 Receipts for Paper Makers, Dyers, Bleachers, Furriers, Hatters, Straw Work, Waterproofing, Cleaning, Laundry Secrets, Soaps, Washing Powders, Aniline Colors, etc. Matches, Colored Fires, Fire Kindlers, Composition, Roofing, etc.

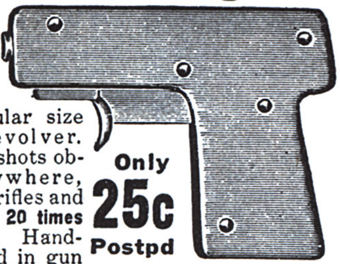
400 ITEMS FOR HUNTERS, TRAPPERS, TAXIDERMISTS, TANNERS, CURRIERS, BOOT, SHOE, AND HARNESS MAKERS, RUBBER MANUFACTURERS. 200 Items for Bakers, Cooks, etc. Items for CARRIAGE AND WAGON MAKERS, CARPENTERS, MARBLE AND STONE CUTTERS, ARCHITECTS, ETC. Struggles, Triumphs, and Portraits of Noted Engineers, 10,000 Trade Secrets and Scientific Facts, 461 Tables, with over 500,000 calculations in every Occupation, Business Forms, all kinds Patent Office Rules, Fees, etc.

FOR MERCHANTS AND BUSINESS MEN: Cardinal Rules for Success in Trade, Advertising, Attracting Customers, Business Locations, Marking of Goods, Buying and Selling, Cash and Credit Systems. How to deal with Incorrigibles who never Pay. Arrangement of Goods in Store, on Commercial Travelers. How to do Business with Banks, Legal Advice, etc.; a Synopsis of the Special Laws of 49 States, Territories, and Provinces in the United States and Canada, relating to the Collection of Debts, Exemptions from Forced Sale, Homestead Laws, Mechanics' Lien, Assignment, Garnishment, Arrest and Attachment for Debt, Collection of Bills and Notes, the Jurisdiction of Courts. Judgments, Executions, Chattel Mortgages, Transfer of Real Estate, Deeds, Rights of Married Women, Wills, Limit of Time in Actions for Debt, Interest and Usury Laws, etc.

JOHNSON SMITH & CO., Dept. 927 54 W. Lake St., CHICAGO

Automatic Repeating Rifle

Fires 20 Shots in One Loading



Only 25c Postpd

This is a regular size automatic revolver. Shoots B. B. shots obtainable anywhere, same as other rifles and guns. **Repeats 20 times with one loading.** Handsomely finished in gun metal. No caps or load necessary. as it works with a spring and shoots with rapidity and accuracy. Simply load with 20 B. B. shot, then press the trigger. Nothing to explode — absolutely harmless and safe. Remember, it is not a mere toy, but the same size and shape as a REGULAR AUTOMATIC. Sent complete with a round of shot for ONLY 25c postpaid

JOHNSON SMITH & CO., Dept 927. 54 W. Lake St., Chicago

"The Baby" Double Action Hammerless Revolver

A Handsome and Most Effective Weapon. Measures But 4¼ Inches Long. Takes Regular .22 Calibre Cartridges $3.50

The new **Baby Double Action Hammerless Revolver** has been produced to meet the ever increasing demand for a revolver that would combine small size and light weight with the essential features of **Efficiency and Practicability.** It is small in size, yet is just as effective and serviceable as the most expensive weapon you can buy. Everyone should have a revolver and should know how to use it, and there is no safer or better one made than this. A great feature is its safety action that guards against accidental discharge, making it quite safe for young men and ladies. The illustration gives an idea of its appearance, but it must be seen and used to be thoroughly appreciated. The ammunition used is the standard 22-calibre cartridge obtainable anywhere. The operation of the charging mechanism is extremely rapid and absolutely reliable; six well aimed shots can be fired in as many seconds. The revolver is very well constructed, with finest nickel plated fluted barrel of cylinder, and it weighs only 4½ ounces. The price of the Baby Revolver is only $3.50, sent by mail, p.pd. to any address.

JOHNSON SMITH & CO., Dept. 927, 54 W. Lake St., CHICAGO

LUMINOUS PAINT

Make Your Watches, Clocks, Etc., Visible by Night The very latest discovery in the scientific world. Hitherto, practically unobtainable except at an exorbitant price, we have at last succeeded in producing this remarkable LUMINOUS PAINT, which, applied to the surface of any article, **emits rays of white light,** rendering it **perfectly visible** in the dark. **THE DARKER THE NIGHT, THE MORE BRILLIANT IT SHINES.** Quite simple to use. Anyone—you can do it. A little applied to the dial of your watch or clock will enable you to tell the time by night. You can coat the push buttons or switch plates of your electric lights, match boxes, and innumerable other articles; make your own Luminous Crucifixes, Luminous Rosaries, etc. Bottle containing sufficient to coat several small articles, **Price 25c.** Larger sizes 50c and $1 postpaid. Johnson Smith & Co., Dp. 927 54 W. Lake St., Chicago

NEW BOOK ON

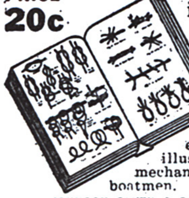
ROPE SPLICING

Useful Knots, Hitches, Splices, etc.

How Different Knots Are Made and What They Are Used For

INDISPENSABLE TO EVERY MECHANIC AND RIGGER

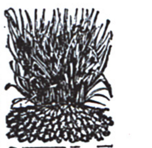
PRICE 20c



A most practical handbook giving complete and simple direction for making all the most useful knots, hitches, rigging, splices, etc. Over 100 illustrations. All about wire rope attachments, lashing, blocks, tackles, etc. 37 Heraldic Knots illustrated. Of great value to mechanics, riggers, campers, boatmen. **Price 20 cents postpaid.**

JOHNSON SMITH & CO., Dept. 927, 54 W. Lake St., Chicago

GROUND ALMONDS



Amazingly Prolific—Easily Grown From Seed

The Ground Almond has a flavor that is MOST EXCELLENT, resembling the cocoanut. The meat is snow white, covered with a shell or skin of brown color. It grows close to the surface and anything from 200 to 300 Almonds may be expected from a single nut. There is no trouble whatever in growing anywhere and in any kind of soil. May be planted any time, and in eight or ten weeks from time of planting you will have an ENORMOUS CROP of the MOST DELICIOUS ALMONDS YOU EVER TASTED. **Seeds 15c Pkt.**

Shoo Fly Plant

A very remarkable Botanical curiosity you should have. Though quite odorless, flies will not remain in a room where it is grown. Bears very pretty blossoms; blooms summer and winter. Grows rapidly from seed.

SEEDS 15c. packet. 3 for 40c. postpaid.

Weather Plant

NATURE'S WEATHER PROPHET

By mysterious changes that take place, this remarkable plant accurately forecasts the weather many hours in advance. Will grow anywhere all the year around. An interesting house plant. Bears large, fragrant, pink, butterfly shape flowers.

Seeds. 15c packet, 3 for 40c, postpaid

JOHNSON, SMITH & CO., Dept. 927, 54 W. Lake St., Chicago

MUSICAL KAZOO

With the Musical Kazoo you can, without previous practice whatsoever, play any tune right off, imitate any bird or animal, bagpipe, snare drum, Punch and Judy, etc. No holes to finger. It is simplicity itself. Produces excellent music. You do not blow into it, but sing, speak, laugh or make any desired imitation. Used with astonishing results at society meetings, home, club or church entertainments, dances, serenades, picnics, outings, excursions. Just the thing for choruses and shows, bicycle and marching clubs, etc. Excellent for vocal or instrumental accompaniments, either with or without other musical instruments. Price 15c p. pd.

MAGIC FLUTE

Wonderfully Sweet Toned and Musical

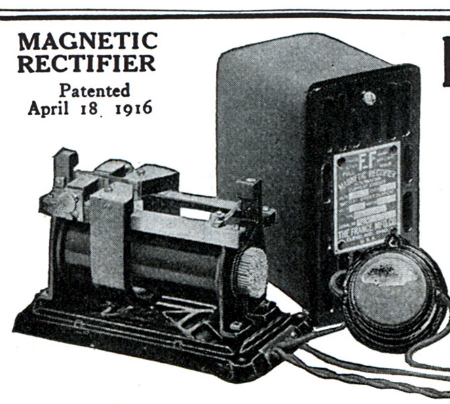
Post Paid 15c

A marvelous musical instrument. No other instrument produces sweeter music, whether it be the joyous notes of a quick-step or the solemn strains of a church hymn—in fact, any class of music can be played upon the Humanatone without practice, as it is almost a self-playing instrument. When played with a piano accompaniment, or any other musical instrument, the effect is charming. Full printed instructions for playing sent with each instrument.

JOHNSON SMITH & CO. Dept 927, 54 W. Lake St., CHICAGO

MAGNETIC RECTIFIER

Patented April 18 1916



F-F BATTERY BOOSTER

Full Wave A. C. Rectifier

BE YOUR OWN SERVICE STATION

For Public or Private Use

The Booster can be carried to the battery wherever it is located and is ready to work when the attachment plug is connected to a lighting or power circuit. It offers the most efficient and satisfactory means for charging all types of storage batteries where only alternating current is available.

We furnish complete portable Charging Rheostat with ammeter and current regulator for service on D. C. circuits.

$24 Complete, and up

F. O. B. Cleveland

THE FRANCE MANUFACTURING CO., Cleveland, Ohio

Ask your dealer or write for Bulletin No. 12

RADIUM IN JAPAN.

A careful investigation of Japan's mineral and hot springs proves her to be the richest country in the world in radium-bearing waters.

The U. S. Government, ever on the alert for any aid to efficiency, is giving the electric potato peeler a thoro test. This should make things a little easier for our "Sammies" and give them more time for "Bagging Boches."

FIXATION OF NITROGEN BY ELECTRICITY.

(*Continued from page* 23)

there is no longer danger of its dissociation, it has then reached so to say a safe harbor. In order to do this rapid cooling it is necessary that the air be past very rapidly thru and out of the high temperature of the electric arc, or better still that the electric arc be past very rapidly thru the air. This latter principle is carried out in the famous Birkeland-Eyde process which is used at present on a large scale in Norway, Germany and other European countries. The Birkeland-Eyde system is illustrated in figure 1.

Two large electro-magnets A and B are placed on both sides of a powerful electric arc C. When these electro-magnets are energized we have practically the same disposition as in the well-known magnetic blow-outs, that is to say, that the arc C will be moved or blown away by the magnetic field which crosses it at right angles. As this arc is being blown out entirely, there should be provided some means by which it can be re-establisht every time that it is blown out. In the Birkeland-Eyde process this is done by using an electric pressure of 5,500 volts across the electrodes. This high pressure jumps a spark across the distance D every time that the current ceases. This spark immediately starts a new arc, and in this way a rapid succession or train of electric arcs is obtained. In reality the electrodes between which the arcs take place are hollow and water cooled and they are shaped as represented in figure 2.

As alternating currents are used in this system, the arcs are blown alternately in the direction E, and then again in the direction F. The result is a series of huge electric flames of semi-circular shape as represented by the dotted lines, growing rapidly from the center and moving at a tremendous speed away from the center. The air thru which these arcs are being drawn becomes very rich in nitric oxid, and it is continuously drawn away. After it is cooled off it is mixed with more air so that the nitric oxid gas which it contains oxidizes still higher and then it is past thru water with which it combines to nitric acid. It is claimed that *about two per cent of the air* which has been treated in this way is gained in the shape of *nitric oxid gas*. As this efficiency considered in itself is rather low, the electric power used in this process must be cheap in order to make it pay. It is for this reason that the plants for this electric fixation of nitrogen out of the air are almost invariably located in the mountains where cheap water power can be directly converted into the required electric power. The plants using this system claim to produce 600 kilograms of nitric acid per kilowatt per year. A remarkable feature of this electric system is that it requires nothing in the way of materials *but water and air.*

The Shönherr process of fixation of nitrogen by means of electricity is illustrated in figure 3.

A long electric arc of *twenty feet* is maintained between an electrode A and the inside wall of a long iron tube B. By means of a water-jacket C, the upper part of the iron tube is kept cool, so that the electric arc, which has a natural tendency to

climb up against the inside wall of the tube, can not extend farther than the line M—N. Air is forced thru this iron tube from the bottom upwards. This air passes then thru the electric arc and thus nitric oxid is formed. When this air reaches the line M—N where the cooled part of the iron tube begins, it is suddenly cooled off and consequently secured against dissociation. The obtained nitric acid gas is then first oxidized to a higher degree by intermingling with more air and finally treated with water so that nitric acid is obtained. In this Shönherr process an electric pressure of 5,000 volts maintains the long electric arc. Alternating currents are used here also.

By means of side openings, the air which is blown thru the tube is given a gyratory motion, which results in the electric arc being maintained exactly along the centerline of the tube.

The Pauling process is illustrated in figure 4.

Here an alternating current of 4,000 volts pressure maintains an electric arc between two curved horns surrounded by fire-brick as represented in figure 4. This arc, when establisht, is driven upwards by a blast of air and is disrupted by the diverging horns. Then a new arc sparks over at A, and so on. The effect is to create an arc flame about *thirty inches high* and to have this flame in intimate contact with the rapidly moving air used to blast the arc flame. Here also the obtained nitric oxid gas is first oxidized to a higher oxid and then past thru water so that nitric acid is formed.

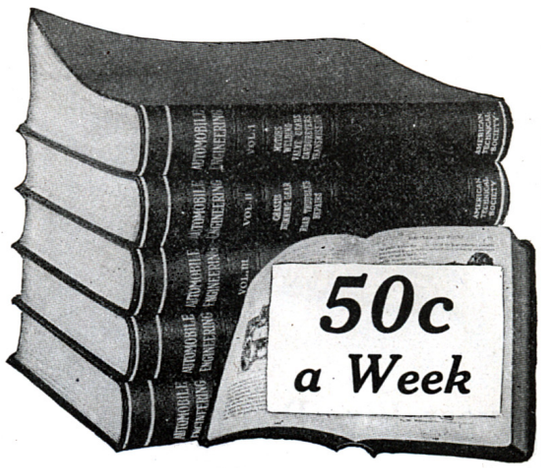
The Pauling and the Shönherr processes compete favorably with the more famous Birkeland-Eyde process. All three processes are used on a large scale in many European countries, but have hardly found their way as yet in America.

THE PHENOMENA OF ELECTRICAL CONDUCTION IN GASES.

(*Continued from page* 25)

As ions can neither be seen or separated in order to measure their individual velocities, there is no way in which we can time them directly as we can, let us say a race horse or a cannon ball. The method of Weichert, however, is both a direct and a very ingenious one. He constructed a tube in which the cathode rays were made to vibrate back and forth across a screen which had a small aperture in it, and behind which another screen was located. The swinging of the rays was controlled by an oscillating field of high frequency, the period of which could be calculated. The arrangement was so timed that the rays past the first screen at the end of their swing to one side, and reached the other screen in the middle of their swing back again, so that the time taken for the rays to pass from one screen to the other was just equal to a quarter period of the oscillating field. The number of oscillations of the field was determined by small condensers whose capacity were known; hence it only remained to calculate the time for a quarter vibration, and reduce the distance for that time to centimeters per second.

This method, however, was quite difficult and inaccurate, and the honor of making the classic determination of the velocity of such ions must be awarded to J. J. Thomson. Altho an indirect method, it is very simple and for this reason also quite accurate. His method was to pass the current thru the tube shown in Fig. 4, allowing the ions from the cathode C to pass thru a small perforation in the anode A, to a luminous screen at the opposite end of the tube. At the point EE and MM, however,



Pay-Raising Books at Reduced Prices

Here's your chance to get—**at bargain price**—a set of books that will fit you for a better job and bigger pay. Yes, and you may pay the bargain price at the rate of **only 50c a week.** But you must act now! The rising cost of paper and binding materials won't permit us to continue this offer indefinitely.

No matter what your occupation, one of the sets listed below is bound to suit your needs. They are written in easily-understood language by recognized authorities, and contain thousands of photographs, full-page plates, diagrams, etc., that make difficult points as simple as A-B-C. Handsomely bound in half or full morocco leather, gold stamped.

Shipped for 7 Days' Examination

We'll gladly send any set of books to you for seven days' examination, shipping charges collect. Examine them carefully—use them at your work for an entire week. If, at the end of that time, you feel they aren't worth many times what we ask, send them back to us. If you keep them, pay the specially reduced price on the easy terms explained below.

Practical Home Study Books

	Vols.	Pages	Size of Page	Illus.	Reg. Price	Spec. Price
Civil Engineering	9	3900	7x10	3000	$45.00	$29.80
Architecture, Carpentry and Building	10	4760	7x10	4000	50.00	24.80
Accountancy and Business	10	3680	7x10	1987	50.00	24.80
Steam Engineering	7	3300	7x10	2500	35.00	19.80
Applied Electricity	7	3000	7x10	2600	35.00	19.80
Automobile Engineering	5	2400	5½x8¾	2000	25.00	17.80
Telephony and Telegraphy	4	1728	7x10	2000	20.00	12.80
Modern Shop Practice	6	2300	5½x8¾	2500	30.00	18.80
Heating, Plumbing and Sanitation	4	1600	7x10	1600	20.00	14.00
Mechanical and Architectural Drawing	4	1720	7x10	1037	20.00	12.00
Motion Picture Work	2	600	7x10	300	12.00	6.00
Law and Practice (with Reading Course)	13	6000	7x10	24	72.00	39.80

Only 50c a Week

If, after seven days' examination, you decide to keep the set you have selected, send us $2 and then $2 a month until the present low price has been paid.

Don't wait. This means money in your pocket if you act now. Remember, you take no chances whatever. This offer is open to every man living within the boundaries of the U. S. and Canada. Mail the coupon **now.**

AMERICAN TECHNICAL SOCIETY
Dept. X7445, Chicago, U. S. A.

SPECIAL DISCOUNT COUPON

AMERICAN TECHNICAL SOCIETY, Dept. X7445, Chicago, U. S. A

Please send me set of.....
.....

for 7 DAYS' examination. I will pay small shipping charge. I will examine the books thoroughly and, if satisfied, will send $2 within 7 days and $2 each month until I have paid the special price of..... If I decide not to keep the books, I will notify you at once and hold them subject to your order. Title not to pass to me until the set is fully paid for.

NAME .....
ADDRESS .....
REFERENCE .....

CHEMCRAFT YOUR OWN LABORATORY

Do you like to do chemical experiments? Here's your chance to have all kinds of fun and at the same time to learn lots about chemistry. A Chemcraft outfit is ready for you with dozens of wonderful experiments and complete equipment of chemicals and apparatus.

With Chemcraft you are not limited to the experiments in the instruction books for you can invent many new experiments of your own.

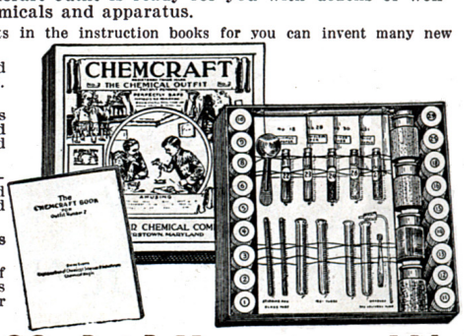
Chemcraft No. 1 has directions for 40 experiments and all the necessary chemicals and apparatus. Price $1.25. West of the Mississippi and Canada, $1.50.

Chemcraft No. 2 has directions for nearly three times as many experiments and includes all the chemicals and apparatus. Price $2.50. West of the Mississippi and Canada, $3.00.

Chemcraft No. 3 has directions for more than 200 experiments and a complete equipment of chemicals and apparatus. Price $5.00. West of the Mississippi and Canada, $6.00.

Don't forget about the Chemcraft Chemist which is free to all owners of the No. 2 and No. 3 sets.

Be sure to remember the name—CHEMCRAFT—and if your toy dealer or department store hasn't it, write us and we will tell you the name of the nearest dealer who can supply you.



THE PORTER CHEMICAL CO., Dept. B, Hagerstown, Md.

Practical Electrical Education

WE teach by practical work and approved scientific methods **Practical Applied Electricity** in one year, **Commercial Engineering** in two years, and **Electrical Engineering** in three years.

½-day lectures and laboratory work, ½-day employment in leading concerns. Part time employment secured for students and positions guaranteed to graduates.

Short Trade Course

gives you big advantage when drafted. See Special Half-Year Courses listed on coupon.

Home Study Course

If you cannot come to us, or do not want to give up your present occupation, we will furnish you by mail at small cost our theoretical course, all payments made to be deducted when you are ready to enter our school at Milwaukee.

Classes now forming for next term

Mail the coupon for free illustrated catalog.

SCHOOL OF ENGINEERING OF MILWAUKEE
40-373 Broadway **Milwaukee, Wis.**

Mail This Coupon Now

SCHOOL OF ENGINEERING OF MILWAUKEE

Check Course Interested In.

Gentlemen: I am interested in:

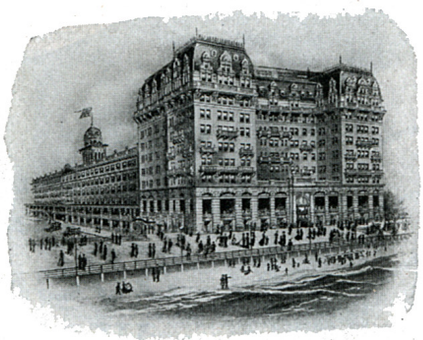
Special Half-year Courses

....Complete Electrician Course, D. C. and A. C. 1 year
....Commercial Engineering 2 to 2½ years
....Electrical Engineering 3 years
....Extension Home Study Course
....Electric Trouble and Lineman
....Electric Meterman
....Electric Wireman
....Electric Motor Repairman
....Telephone Trouble and Repairman
....Draf'sman

Name .....
Age ..... Education .....
Address .....
City ..... State .....

The Breakers

on the
ocean front



Atlantic City's Newest Fire-Proof Hotel

offers unusual attractions during Autumn and Winter Seasons. Luxurious lobbies, spacious verandas, restful sun parlors and superb music. A palatial residence for those seeking rest and recreation.

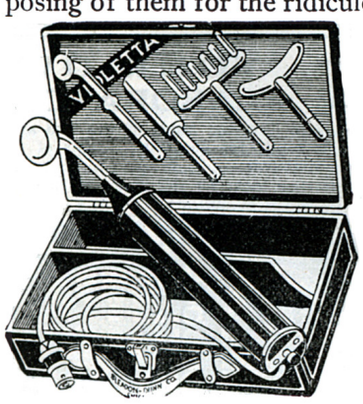
American and European Plans

Illustrated literature and terms mailed
Garage with accommodations for chauffeurs.

High Frequency Bargains

In taking our inventory we found over 200 Violet-Ray machines of all makes. We selected 100 of the best machines, which we thoroughly overhauled in our factory making them better than new. Many of these machines cost over $40.00.

We have placed all these instruments in two groups and are disposing of them for the ridiculously low price of **$9.75** and **$12.50.**



How to secure one of these machines

Send only 50 cents to pay express charges and we shall send you one of these instruments by express for your examination. This amount will be deducted from total cost of machine. You need not accept if not satisfactory.

Send at once for we shall send the *best machines out first* and the quicker you send in your order, the better machine you will get.

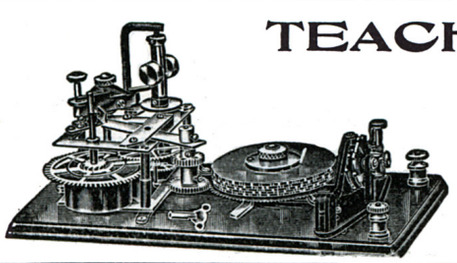
We shall also send our beautiful booklet *"Violetta"* describing the many uses for the high-frequency current. Write us before purchasing any kind of Violet-Ray Machine.

BLEADON-DUN CO., 11-17 S. DESPLAINES ST. Dept. 2A CHICAGO

"THERE'S MONEY IN IT"

LEARN TELEGRAPHY AT HOME — AT HOME
MORSE AND WIRELESS

TEACH YOURSELF



in half the usual time, at trifling cost, with the wonderful Automatic Transmitter, **THE OMNIGRAPH.** Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would.

Adopted by U. S. Gov't. 4 styles. Catalogue free.

OMNIGRAPH MFG. CO.
39L Cortlandt St. New York

SAVE 25% to 60%
on slightly used
GRAFLEX - KODAKS
Cameras and Lenses of every description. Equal to new. Save money. Write now for **Free Bargain Book and Catalog** listing hundreds of money-saving bargains in slightly used and new cameras and supplies. **All goods sold on 10 days' Free Trial.** Money back if not satisfied. You take no chances dealing with us. We have been in the photographic business over 16 years. **Write Now**

CENTRAL CAMERA CO., Dept. 175, 124 So. Wabash Ave., Chicago

Convert Your Bicycle Into a Motor-Cycle

We sell you the motor complete or furnish you with the finished parts from which you can build the motor yourself with few tools **We send you the printed instructions with blue prints of the drawings for $.25 or full particulars for 3-cent stamp.**

STEFFEY MFG. CO., 5025 Brown St., Phila., Pa.

two electrodes EE, and the poles of an electromagnet MM, were situated at right angles to each other so that the rays could be deflected in opposite directions by either a magnetic or electric field. The procedure was then to first deflect the rays by an electric field of known strength to any point B on the luminous screen; then to increase the magnetic field in the opposite direction until the rays were just brought back to their original position again.

By knowing the strengths of both the magnetic and electric fields it is easy to calculate the velocity of the rays, for it is a well-known fact that the force of an electric field on an ion *does not* depend on the velocity of the ion, while the force of a magnetic field on an ion *does* depend on the velocity of the ion, or in other words upon the *number of lines of force it cuts per second.* These facts may be exprest by simple formulas well known to students of physics, as follows:

$$\text{Magnetic force} = H\ e\ v \text{ and}$$
$$\text{Electric force} = V\ e \text{ where}$$

H and V are the strengths of the electric and magnetic fields respectively, "e" is the charge on the ion and "v" is the velocity of the ion. In the experiment the rays were brought back to zero so that it is evident both fields are equal, therefore:

$$H\ ev = V\ e,$$

or $v = \frac{V}{H}$ whereby the velocity is determined from V and H which are known, or can be measured.

From such determinations it has been found that the positive ions in a tube like the one shown may travel as slow as 600 *miles per second,* and from their speed they are identified as *helium atoms.* Others traveling at approximately 2,000 *miles per second* appear to be hydrogen atoms, which are the smallest positive ions so far known. The *negative* ions travel in such a tube at about 100,000 *miles per second* or even as high as the velocity of light, and are without doubt *free electrons.* Under other conditions much slower moving ions are found than any mentioned and they probably correspond to the groups or clusters noted earlier. Much work is now being done to determine the nature of ions under different conditions, and this bears directly on the problem of the nature of *Electricity* itself.

EXTERNAL GRID VACUUM VALVE DETECTOR CONSTRUCTION.

(*Continued from page* 28)

A glimpse of a semi-finished detector is presented in Fig. 3, in which the outside grid has been lowered to give a clear view of the interior of the bulb. In this picture the base wires are shown separated, but not connected to the necessary leads which are shown elsewhere.

Some idea of the finished appearance of our detector can be gained from a survey of Fig. 4. The grid on these valves is made of perforated aluminum or nickeled brass. The holes can be punched by hand or the material bought in the finished state.

It may be that some who glance at this article will form the opinion that the detectors illustrated will not give good results on account of the small area and positions of the internal parts. This, however, has not proved the case, as the author's experiments with the bulb actually pictured here have proved them quite sensitive under the right conditions.

The matter of current regulation with this valve is a rather important one. In

order to operate the valve efficiently the filament must burn brightly and should be fed at about 20% above the specified voltage, the exact amount varying with changing conditions. An accurate low voltage rheostat is essential for the proper handling of any hot filament rectifier, and especially so in the case of our instrument. The regulation of the *high* voltage battery, however, presents the greatest variation from common practise, and therefore affords much opportunity for research work.

A 'phone circuit battery of about 60 *volts* is generally considered quite sufficient for the majority of present-day valve detectors, but in the case of the bulbs under consideration it is best to command a high potential of up to 70 *volts*, altho very good results can be obtained with as little as 50 volts. The current from the cells which form this battery must be controlled by a *potentiometer* of very high resistance or, better still, several pairs of high resistance 'phones can be substituted therefor. The author has found during his tests that a potential of about 75 volts, subjected to the retarding effect encountered by using the skin of the hand or fingers as a rheostat, gave unusually good results.

The idea of using part of one's body as a current regulator is, of course, impractical, but the resultant effect is so striking that it leads the author to believe that a new instrument may be developed to take the place of the present potentiometer, which is known to be a very wasteful instrument. An adjustable bank of receivers of different resistance but similar pitch, connected with a common sound chamber or horn, should entirely eliminate the need of a potentiometer. There is also a chance of employing a variable condenser in this connection to approximate the capacity effect obtained in using the body as a resistance.

During the war it will naturally be impossible to test out any form of wireless instruments, except in the laboratory, where some type of non-radiating circuits must be utilized, and even there a buzzer practise set would constitute the limit of sending power available now. No aerial or ground connections are permitted under the recent Radio Act.

For the real electrical experimenter and research worker there still remains a wide field in which to work with any type of valve-amplifier that is not too highly valued to experiment with. Two of the many possible uses to which electronic relays can be put outside the radio field are considered separately in the following paragraphs.

Hot filament valves are slowly coming into use as rectifiers of electric current in commercial stations, but are still considered in the chrysalis, or unfinished state. The great draw-back in using bulbs for this purpose lies in the excessive waste of filament which takes place, making the rectifier very short lived. It would be folly to use an expensive instrument for experiments along this line, but one of our lamps, which cost only about 60c to replace, may be used without one's being considered extravagant. By using the filaments interchangeably at intervals of a few hours each it may be possible, under the right conditions, to greatly increase the active life of these bulbs when used as model rectifiers.

The most wonderful property of the vacuum valve, and the one which holds the most in store for the inventor, is doubtless its ability to act as an amplifier. For increasing, indirectly, electrical energy and mechanical motion the electronic valve presents a very desirable medium. Many systems of automatic sound control are being developed with the aid of the amplifier valve. There is no limit to the possibilities of experimentation in this direction. Loud-speakng megaphones, phonographs, telephones, horns, ad infinitum, all await development. Submarine destroying devices, aerial torpedoes, locating apparatus of all kinds, can be invented which will prove to be the undoing of things out of sight, but not out of the hearing of the delicate ear of the microphone, augmented and sensitized by the addition of an amplifier bulb.

It is the author's hope that the foregoing ideas may prove of real interest to a very large class of readers.

Important Notice to Subscribers

Due to the congestion existing at the present time in all railroad movements, also on account of the fact that many train clerks have gone to war, there is a congestion of mails all over the United States. It may happen that your magazine will be slow in reaching you, and this delay may be from a few days up to several weeks.

Kindly bear this in mind before sending in a complaint, as the magazine will surely reach you in due time. Only after not having received a certain copy for a period of three weeks should a complaint be sent in.

You will confer a favor upon the publishers not to write until this time has elapsed, thereby saving them a vast amount of clerical labor.

THEORY OF TUNING, WAVE LENGTHS AND HARMONICS.

(*Continued from page* 33)

terminals of the parts of a circuit can be more than that which is applied to the whole circuit.

The relation of the different pressures may perhaps best be represented by such a diagram as shown in figure 3, in which the two pressures of 2,915 volts are shown at such an angle with each other as to form a *resultant* pressure equal to 110 volts. The two large pressures are very greatly out of phase with each other, so that their geometric resultant on this composite mutual effect is really only 110 volts.

The next step in the development of our discussion should be to consider what will happen in the circuit, and the numerical effect on the equations given, if the *frequency* of the applied pressure is doubled; that is, f is to become 120 cycles. In this case $2\pi f = 754$, very nearly. Supposing the condenser is the same as used when the frequency was 60 cycles; the value of

$$2\pi f C = 754 \times \frac{1}{100{,}000} = .00754 \text{ and } L = \frac{1}{.00754 \times 754} = 0.17 \text{ henry.}$$

It is thus evident that with a given condenser having an unchanging capacity, if the frequency is doubled, the value of the inductance must be decreased four times in order to produce a condition of complete resonance in the series circuit.

The current in the circuit under the new condition of doubled frequency will be the same as with the original frequency of 60 cycles, provided the ohmic resistance has not been changed, and likewise the pressures between the terminals of the condenser and of the coil will be 2,915 volts as before. In order to decrease the inductance four times, the number of turns in the coil, or included in the circuit by the contact P will need to be only one-half as many as were originally included. If the number of turns were decreased threefold the inductance would be reduced ninefold.

(*Continued on page* 62)

$2.50 a Month

The masterpiece of watch manufacture—adjusted to the second, positions, temperature and isochronism. Encased at factory into your choice of the expuisite new watch cases.

21 Jewel Burlington

All sizes for both men and women

The great Burlington Watch sent on simple request. Pay at rate of $2.50 a month. You get the watch at the same price even the wholesale jeweler must pay.

Write Today for Free Watch Book

See handsome color illustrations of all the newest designs in watches that you have to choose from. Your name and address on a postcard is enough. Get this offer while it lasts. Write today.

Burlington Watch Co. Dept. 7445 19th & Marshall Blvd. Chicago

414 PAGES 145 ILLUSTRATIONS

I.C.S. ELECTRICAL ENGINEER'S HANDBOOK

50¢

ELECTRICITY!

HERE'S just the book on Electricity that you need to answer your many questions—to solve your knotty problems, to teach you new kinks, to be your memory for tables, rules, formulas and other Electrical and Mechanical facts that some people try to carry in their heads—and fail.

With this "Little Giant" I. C. S. Electrical Engineer's Handbook in your pocket, tool chest, on your work bench, drawing table or desk, an hour or a day need not be lost "digging up" some forgotten rule, some unfamiliar fact; you'll just turn to the very complete index and get it "in a jiffy." Just a few of the subjects treated are:

Electricity and Magnetism; Electrical Symbols; Batteries; Circuits; Magnets; Direct and Alternating Currents; Dynamos and Motors; Belts; Shafting; Electroplating; Electrical Measurements; Meters; Arc and Incandescent Lamps; Mercury Arc Rectifiers; Transformers; Insulation; Electric Cars; Single and Multiple-Unit Control; Transmission; Rail Welding; Tables of Wires—Sizes, Capacities, etc.,—Mathematical Rules, Formulas, Symbols; Tables of Constants, Equivalents, Roots, Powers, Reciprocals, Areas, Weights and Measures; Chemistry; Properties of Metals; Principles of Mechanics; First Aid, etc.

The Electrical Engineer's Handbook is one of 22 I. C. S. Handbooks covering 22 Technical, Scientific and Commercial subjects, all crowded with value. They have the contents of a full-sized book condensed into pocket-size ready to go with you anywhere and be at your instant command. They are substantially bound in cloth, red edges, goldleaf stamping, printed from new, clear, readable type on good quality book paper. There is an illustration at every point where a picture will help. Hundreds of thousands have been sold on a money-back guarantee of satisfaction.

The former price of these Handbooks was **$1.25**, but

THIS MONTH you can buy the ones you want for only 50c each, postpaid

(For 10c extra we will send a cloth-covered protecting case.)

You Run No Risk! Money Back if Desired!

International Correspondence Schools

Box 5382, Scranton, Pa

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS

Box 5382, SCRANTON, PA.

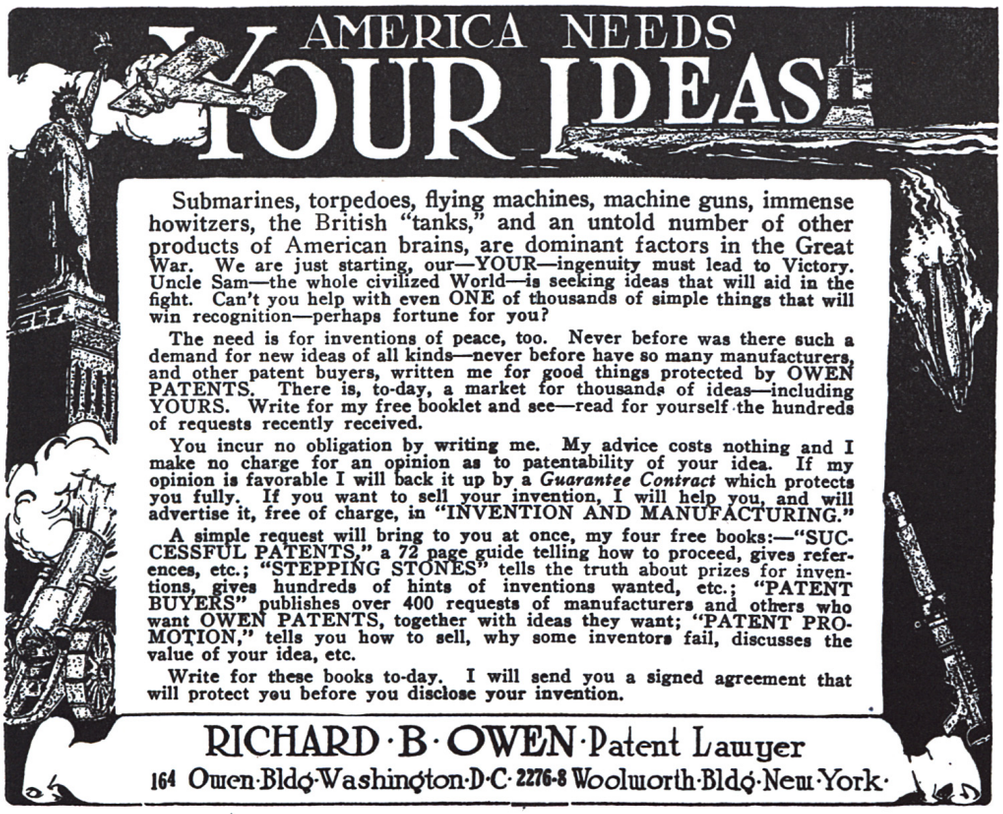
I enclose $ ____ for which send me postpaid the Handbooks marked X, at 50c. each. I may return any or all and get my money back within ten days from receipt:

☐ Electrical Engineer's	☐ Advertiser's
☐ Teleph. and Teleg. Engineer's	☐ Business Man's ★
☐ Mechanic's	☐ Bookkeeper's
☐ Steam Engineer's	☐ Steno. and Correspondent's
☐ Westinghouse Air Brake	☐ Salesman's
☐ Civil Engineer's	☐ Window Trimmer's
☐ Coal Miner's	☐ Cotton Textile Worker's
☐ Concrete Engineer's	☐ Farmer's
☐ Building Trades	☐ Poultryman's
☐ Plumber's and Fitter's	☐ Mariner's
☐ Chemist's	☐ Automobiles

Name ____

Street and No. ____

City ____ State ____



AMERICA NEEDS YOUR IDEAS

Submarines, torpedoes, flying machines, machine guns, immense howitzers, the British "tanks," and an untold number of other products of American brains, are dominant factors in the Great War. We are just starting, our—YOUR—ingenuity must lead to Victory. Uncle Sam—the whole civilized World—is seeking ideas that will aid in the fight. Can't you help with even ONE of thousands of simple things that will win recognition—perhaps fortune for you?

The need is for inventions of peace, too. Never before was there such a demand for new ideas of all kinds—never before have so many manufacturers, and other patent buyers, written me for good things protected by OWEN PATENTS. There is, to-day, a market for thousands of ideas—including YOURS. Write for my free booklet and see—read for yourself the hundreds of requests recently received.

You incur no obligation by writing me. My advice costs nothing and I make no charge for an opinion as to patentability of your idea. If my opinion is favorable I will back it up by a *Guarantee Contract* which protects you fully. If you want to sell your invention, I will help you, and will advertise it, free of charge, in "INVENTION AND MANUFACTURING."

A simple request will bring to you at once, my four free books:—"SUCCESSFUL PATENTS," a 72 page guide telling how to proceed, gives references, etc.; "STEPPING STONES" tells the truth about prizes for inventions, gives hundreds of hints of inventions wanted, etc.; "PATENT BUYERS" publishes over 400 requests of manufacturers and others who want OWEN PATENTS, together with ideas they want; "PATENT PROMOTION," tells you how to sell, why some inventors fail, discusses the value of your idea, etc.

Write for these books to-day. I will send you a signed agreement that will protect you before you disclose your invention.

RICHARD·B·OWEN·Patent Lawyer

164 Owen·Bldg·Washington·D·C· 2276-8 Woolworth·Bldg·New·York·

PATENT YOUR IDEAS

—is there an invention tucked away in your brain?

IF so, now is the time to produce it. Manufacturers everywhere are demanding new articles to keep up big production. ***Their wants must be supplied.***

This is your opportunity!

Many manufacturers have written us saying just what they are looking for; we will send you this

List of Inventions Wanted, Free for the Asking

Hundreds of other manufacturers have written us for *anything new and useful*—kitchen utensils, household articles, automobile specialties, labor-saving devices for the office, plant or farm—anything from big machinery to small novelties—anything to save time, make work easier, or do its work better. Thousands of new plants have been built and others have been enlarged. Many are making articles for which there is *only temporary* sale. All want something which they can build to sell as a steady, *permanent* business. Wise manufacturers are laying their plans NOW. This is why they are scouring the country for NEW INVENTIONS. IF YOU HAVE AN INVENTION send us a sketch or model and description and we will give you a FREE OPINION CONCERNING ITS PATENTABILITY. We help our clients sell their patents. Patents applied for through us are advertised for sale free of charge in the Manufacturers' Record. If you have no idea at present, write us for our list of articles called for by manufacturers.

We will also send you our book "WHAT TO INVENT," giving information which everyone should have.

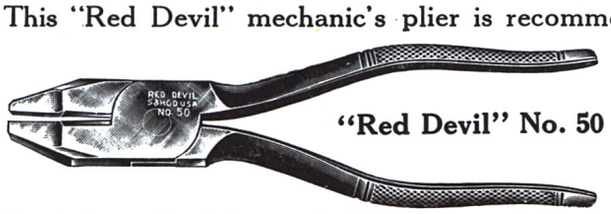
Both the list of inventions wanted and the book are free

CHANDLEE & CHANDLEE, 415 7th St., Washington, D. C.

Patent Attorneys

A Handy Helper for the Shop and Workbench

This "Red Devil" mechanic's plier is recommended for all kinds of practical and experimental work.



"Red Devil" No. 50 **Forged from tool steel, spring tempered. Tested cutting edges, "scientific" handles.**

From dealers, or if not, from us. Send $1.30 for a sample 7-in. tool, style No. 50. Write for Tool Literature.

SMITH & HEMENWAY CO., Inc., 107 Coit St., Irvington, N. J.

PATENT

Edited by

In this Department we publish such matter as those who are in doubt as to certain Patent Advice" cannot be answered by mail free of benefit of all readers. If the idea is thought to divulge details, in order to protect the inventor

Should advice be desired by mail a nominal Sketches and descriptions must be clear and ex ten on.

RADIO TELEPHONY.

(217) B. Taylor, Jr., has an idea to transmit the voice by radio-telephony thru the means of a phonograph. He intends to use a spark system, the spark gap being connected to the needle of the phonograph record in a certain manner. Several other details are also disclosed. Will this device work, and is it practical?

A. A device of this sort will not work, as it has been found that for wireless telephony it is absolutely necessary that you have what is called *undamped wave* control. Any ordinary spark systems for wireless telephony do not work. We advise our correspondent to look up one of the standard works on wireless telephony for full information on this phase of the art.

TOY RAILWAY BLOCK SYSTEM.

(218) Albert Porch, Chicago, Ill., has sent in drawings and description of an electric block system for a miniature railroad. When connected with either an electrical or mechanical railroad, the block system will operate, no matter how many trains are running on the same track, and no matter whether the tracks are double or third-rail.

A. This is a promising idea, and looks quite clever, and we have no doubt that it will work as outlined by our correspondent. On an idea of this kind we would advise to have a patent search made, which does not cost much. The search can be made by any of the patent attorneys advertising in the columns of the ELECTRICAL EXPERIMENTER.

ELECTRIC TRANSPARENCY.

(219) Edward Caffery, Jr., of Houston, Texas, submits an idea by means of which an electric sign can be placed in a hat, the sign to flash certain words or lettering, the idea being to use such a sign for advertising at night. Is this a new idea, and can is be patented.

A. This idea is at least fifteen years old. Some ten years back, the Editor of this column manufactured transparent electric bosom shirts of white celluloid for a local advertising company, as well as transparent signs placed in silk hats. A popular whiskey company was spending at that time a considerable amount of money, and they wanted walking signs of that sort, and the company was gladly accommodated. The men who walked around with these signs carried small electric storage batteries in their hip pocket, from which the current for the lamps was supplied.

OIL ATTACHMENT.

(220) Fred Van Dyke, Detroit, Mich., wishes to know if a device whereby a certain oiling device is attached to stock and dies is new, and whether it can be patented. The idea is that every stock and die needs a good deal of oil, which at the present time is supplied by hand, by means of an oil can. Our correspondent does away with this feature, using an automatic oiling arrangement incorporated in the tool itself. Our advice is asked.

ADVICE

H. GERNSBACK.

is of interest to inventors and particularly to Phases. Regular inquiries addrest to "Patent charge. Such inquiries are publisht here for the be of importance, we make it a rule not to as far as it is possible to do so.
charge of $1.00 is made for each question. plicit. Only one side of sheet should be writ-

A. This is a very clever idea, and quite novel as far as we can see. We have never seen the like of it, and would advise our correspondent to get in touch with a patent attorney.

ENVELOPE.

(221) Leo M. La Fave, Black River, N. Y., has submitted to us a simple combination envelope and letter, the idea being to fold the letter in such a way as to make an envelope out of it. This letter has, of course, a special flap, so that the combination can be sealed. Our correspondent wishes to know if this device is new and patentable.

A. This is not a new device by any means. Quite a good many envelopes of this kind are on the market now, and we know of a number of concerns who are using such envelopes at the present time.

GUN KICK-ABSORBER.

222) Erwin L. Gehrke, Cleveland, O., submits a device to be attached to a gun whereby the back-kick of the gun is absorbed. It is a well-known fact that a soldier firing a gun for a long stretch of time is apt to develop soreness in the shoulder by virtue of the powerful kicking back of the gun. By means of certain spring arrangements, our correspondent intends to do away with this feature.

A. This is by no means a new idea, kick absorbers of this kind exist at the present time, and have existed as far back as one hundred years. Somehow or other the idea does not seem to be very popular with the various governments, particularly nowadays, as a good deal of progress has been made in gun building, and the modern rifle does not give the heavy kick that such guns used to give, as, for instance, the old style musket.

Our correspondent, furthermore, writes as follows: "An idea has come to me concerning a method to heat the water in a boiler. This would be chiefly used in the recently invented 'Doble Car.'" He goes on and describes a system whereby a generator of the correct power is geared to the steam engine, storage battery to be charged by the generator while the car is running, and to be automatically disconnected when charged. The purpose of the storage battery would be to take the place of the generator while the car is at a standstill, in order to keep the correct amount of steam up continually. The heating of the boiler in this case will, of course, be electrical, and our correspondent describes his method minutely.

A. This is a very good idea, but we are not quite certain that it is of any practical value without having it tried out. In a way, the idea is quite new, and there should not be much trouble in patenting it, but we would advise caution, and at least preliminary try-out.

Mr. E. Hume Talbert

INVENT SOMETHING

Your Ideas May Bring Wealth If Patented. Always a Demand for Valuable Inventions.

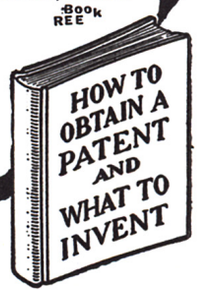
Now is the time to patent a meritorious invention. We are constantly receiving letters from manufacturers and investors who are interested in new devices and specialties that are protected by patents secured through us, and can be turned into money through proper handling. The shortage of labor has increased a demand for inventions in all lines of manufacture and agriculture, and

Uncle Sam Wants New Inventions to Help Win the War

You should write us today for a free copy of our 104-page book "How to Obtain a Patent and What to Invent," and should at the same time send us a sketch, model of photograph with written description of your invention for our

FREE OPINION AND ADVICE

If we report favorably on your invention, we will send you our Certificate and Evidence of Conception of your invention which may prove of value and assistance to you. Our Credit System will enable you to file your application and proceed without delay. Patents secured by us are advertised, at our expense, in Popular Mechanics Magazine. To protect yourself you should write for our free book and submit your invention to us today.



TALBERT & TALBERT, *Patent Lawyers*
(Successors to Talbert & Parker)
4287 Talbert Building **Washington, D.C.**

Patents
procured by a former Examining Official of the U. S. Patent Office, Norman T. Whitaker, Attorney-at-Law and Mechanical Engineer, 480 Whitaker Bldg., Washington, D. C. Inquiries invited.

PATENTS

Patents, Make Your Ideas Pay
Hundreds of inventions are sold yearly. We help market yours without cost. Send sketch for free opinion. Book and suggestions sent on request. **Prompt service. Best results.**
A. M. BUCK & COMPANY
205 2nd National Bank Bldg., WASHINGTON, D. C.

PATENTS WANTED
TRADE-MARKS and COPYRIGHTS
Largest Patent Firm in the World

Victor J. Evans.

Before sending your invention to any attorney or manufacturer or disclosing your invention, write for our free blank form PROOF OF CONCEPTION in order to protect your invention and secure your rights. This should be signed and witnessed and returned to us, together with a model or sketch and description of your invention, and we will give a FREE OPINION as to the patentability of the invention. If we report the invention patentable we will furnish a Certificate of Patentability.

SPECIAL OFFER

This Certificate of Patentability, together with our blank form Proof of Conception will protect the inventor and serve as proof of the invention until the case can be filed in the U. S. Patent office.

OBTAINING ASSISTANCE FOR INVENTORS—Our certificate is of great assistance to inventors who require financial aid to obtain patents

OUR FIVE BOOKS MAILED FREE
(See Coupon Below)
to any address. Send for these books—the finest publications ever issued for free distribution.

HOW TO OBTAIN A PATENT
Our illustrated eighty-page Guide Book is a Book of reference for inventors and contains 100 mechanical movements, illustrated and described. Tells how to invent for profit.

WHAT TO INVENT
Contains a valuable **list of inventions wanted** and suggestions concerning profitable fields of inventions; also information regarding **prizes offered for inventions amounting to ONE MILLION DOLLARS**

LIST OF PATENT BUYERS
Contains requests from manufacturers, mail order houses and promoters for patents secured by us and suggestions as to **New Ideas** they wish to purchase. We place our clients in touch with capital free of charge. We have recently received over 300 requests from manufacturers.

MILLIONS IN TRADE-MARKS
Shows the value of Trade-Marks and information regarding unfair competition
We advertise Our Clients' Inventions Free in a list of Sunday newspapers, in manufacturers' journals and in World's Progress. Sample Copy Free. We save you time and money in securing patents. After the patent is granted we assist you **to sell your patent.**

WANTED NEW IDEAS

FREE COUPON!
VICTOR J. EVANS & CO.
PATENT ATTORNEYS
New York Offices: 1001 to 1007 Woolworth Bldg. **Pittsburg Offices: 514 Empire Bldg.** **Philadelphia Offices: 1429 Chestnut St.**
Main Offices: 779 Ninth Street, N.W., Washington, D. C.
Name ..... ***Address*** .....

$50,000,000 For One Little Idea

The little tin cap with the wrinkled edge that you jerk off of beer bottles and other bottles, that simple little thing has made something like *fifty millions of dollars as a patent!* And the little hook-and-eye that buttons up the ladies' dresses, that tiny invention has also earned several millions on royalties. Thus one could go on mentioning any number of articles that we all handle in our daily life that have made fortunes for the men and women who saw the worth of their ideas and took patents out on them. There's no quicker, surer, or more legitimate way of attaining wealth than through an invention. Yet how few of us take advantage of the opportunities that we all have for producing some profitable invention?

"Tremendous Trifles"

Glass Lemon Squeezer made $50,000 for the Inventor.
Roller Skate has paid $1,000,000 in royalties.
The Suspender Garter patent was sold for $50,000.
Wooden Shoe Pegs earned $500,000 in royalties.
Automatic Ink Well has netted $200,000.
Mrs. Potts' Sad Iron netted over $500,000 in royalties.
Ball and Socket Glove Fastener has passed the million mark.
Return Ball (toy), a rubber ball on a rubber string, yielded $500,000 per year in royalties for a number of years.
These are only a few of the long list of profitable small inventions. What is your idea worth?

What Shall I Invent?

There are two ways of producing an invention. One way by making some improvement on some article or process already in use, the other by conceiving a new, useful device or process or article of manufacture. As to what particular thing to invent, that is entirely up to you. But do not deem it necessary to think of something stupendous or to go into fields beyond your everyday life. Right in your own work, your own home, office or shop there are countless opportunities for invention if you will but reach out for them. Of course, it is well to have some knowledge of inventions and patents to guide you, and for this reason it would be well to have at hand such a book as "Patent Knowledge for Inventors," which can be obtained free by writing George P. Kimmel, the well-known Patent Attorney of Washington, D. C., (88-E Oriental Building, Washington, D. C.)

Send for Free Booklet

It will be well worth your while to send for Mr. Kimmel's free booklet. It will teach you much about patent practice and procedure and will show you how important it is to select the right patent attorney to get your patent and to aid you in selling or promoting it. Experienced inventors as well as the inexperienced should read Mr. Kimmel's **"Patent Knowledge for Inventors."** It is different from the usual stuff sent out by patent concerns. The booklet will be sent free and postpaid on request. Address postcard or letter to

GEORGE P. KIMMEL 88-E Oriental Bldg. Washington. D. C.

PATENTS

Send me your ideas Manufacturers want patents I procure. Prompt, confidential, personal service by successful patent attorney with highest references Honest advice and "The Truth About Patents" Free

J. R. KELLY, 740D Woodward Bldg. Washington, D C

PATENTS

THAT PROTECT AND PAY

Books and Advice Free

If you want to sell your patent, take it out through my office. HIGHEST REFERENCES. BEST RESULTS.

WATSON E. COLEMAN, Patent Lawyer
624 F. Street, N. W. Washington, D. C.

EVERY INVENTOR

should have this book, "PATENTS AND PATENT POSSIBILITIES." It is chock full of ideas and practical advice, telling what to invent and where to sell. Write for your copy today. IT IS FREE.

I have requests for patents upon sound inventions of all kinds. Can you help supply the demand?

My service is individual, prompt and efficient (14 years experience). Every expedient is employed to secure patents at least possible cost

H. S. HILL, 804 McLachlen Bldg., Washington, D.C.

AUTOMATIC SPARK ADVANCE FOR MAGNETOS.

(223) John M. O'Brien, West Winfield, N. Y., submits an idea of an automatic spark advance for magnetos, and wishes to have our advice.

A. This idea looks quite good to us, and seems to have several features that no doubt would be of interest to some of the automobile builders. We think a patent may be obtained on this idea, but would advise a search made by a reputable patent attorney before finally applying for patent.

This correspondent also submits a tank gage remote from the dash of the car. It is an electrical contrivance, and the amount of gasoline in the tank is indicated on an electrical meter.

A. This is a very good scheme, and quite novel we are sure. We think a patent can be obtained upon it. It is one of these little ideas that appeal greatly to the average motorist.

Another idea in the form of a ball bearing is also suggested by our correspondent. He desires to know if it is of any value.

A. There is nothing new contained in this idea as far as we can see. It simply seems to be a variation of some of the ball bearings now on the market.

LIGHTING OUTFIT.

(224) Willard St. John, Hawley, Minn., submits an idea of a lighting outfit which is to take the place of the unit lighting schemes using gasoline engines for motive power, especially where there is a windmill already in operation. A detailed description of the entire scheme is given and our advice is asked.

A. To our mind the device is too impractical and expensive, and we do not think it would replace the outfits on the market now. Also, inasmuch as no new principle is involved, there would, of course, be no chance for patent protection.

COMBINATION AUTOMATIC HEATER.

(225) Robert Bostwick, Jr., Seattle, Wash., has hit upon an idea to combine a heating coil with a fan, all automatically operated. The automatic part is that a certain electric controller is contained in the device, so that when the temperature rises above a certain degree, the fan will start running, thereby cooling the atmosphere. Conversely, if the temperature drops to a certain level the heating coil is connected into the circuit, which in turn throws hot air into the room, thereby heating it.

A. A capital idea; very good and very simple. We are quite sure that our correspondent will find little trouble in securing a patent, which we are also certain should prove valuable. He should get in touch with a patent attorney at once.

AUTO GAS TANK.

(226) L. B. Wilcox, Flint, Mich., submits an idea for an automobile gas tank which is supposed to keep a reserve supply of gasoline. The arrangement is such that the tank automatically acts as a reminder to the driver. In other words, he would not be caught without gasoline far from a supply depot.

A. The idea is good, but it is not of practical value, and we cannot see wherein an ordinary indicating tank gage would not be cheaper and simpler.

An electrically operated machine has been invented for picking the feathers off a chicken, which can pluck all the feathers off within five minutes.

Carbon and electrolytic solutions when heated have their resistance lowered, while metals have their resistance increased when they are heated.

THEORY OF TUNING, WAVE LENGTHS AND HARMONICS.

(*Continued from page* 59)

If the frequency of the applied pressure were increased three-fold—that is, to 180 cycles per second—the necessary inductance to be employed with the given condenser to produce resonance would be

$$L = \frac{1}{1131 \times .01131} = .078 \text{ henry};$$

or one-ninth the amount required originally.

If the applied pressure E and the resistance R of the coil is the same as originally, the current in the circuit will be 11 amperes as before. It is now a simple process to comprehend the application of the foregoing to a wireless receiving circuit, with low resistance telephone receivers connected as indicated in figure 4, or with high resistance receivers connected between the terminals of the condensers as indicated in Fig. 5.

The applied pressure E may be produced by wireless waves acting on the aerial. This pressure E may, of course, be of any value depending upon the energy available at the receiving device due to the distant sending apparatus. There may be three different wave frequencies from these different sending stations operating thru space at the same time, one having *twice* the frequency and a third having *three* times the frequency of the first. By slowly moving the contact P along the turns of the so-called tuning coil the value of the inductance L is so varied as to produce resonance and a maximum current in the telephone receivers for *one* of the frequencies. The pressures due to the other two frequencies may produce a certain small current in the receiving circuit, and weak sounds in the receiver. By moving the contact from the position giving a maximum for one frequency, to another position, a certain position is found such that resonance and a maximum current is produced for another frequency. The maximum current for this frequency produces a much louder note in the telephone receivers than the currents due to the other two frequencies, which are now said to be "tuned out."

The higher the frequency of the wireless waves producing the pressure and resulting current in the receiving circuit, the higher the pitch of the note in the receivers.

It may be well to call to mind the relation of frequency and wave length. The higher the frequency the shorter the wave length, as indicated by the equation $V = f\lambda$, in which V denotes the velocity of propagation or speed of a wave, f denotes its frequency in cycles per second, and λ (Greek letter lambda) denotes the wave length. The velocity V of propagation is the same for all wave lengths. That is, V is a constant; so if f is decreased, then λ must be correspondingly increased.

The importance of the numerical value of the resistance R of the circuit needs consideration. Consulting the original equation

it may be seen that when $2\pi fL = \frac{1}{2\pi fC}$ that the current is exprest by $I = \frac{E}{\sqrt{R^2}} = \frac{E}{R}$;

which shows that at perfect resonance with a given value of applied pressure E, the smaller the numerical value of the resistance of the coil or of the complete circuit, the greater will be the current in the coil or circuit, or in a telephone receiver when connected as in figure 4.

In such an arrangement it is evident that the smaller the resistance of the receivers the greater will be the current in them. However, the sensitiveness of a telephone receiver depends very largely upon the

ampere-turns. When arranged as in figure 5, the receiver would naturally have a much greater resistance than when arranged as in figure 4, since when connected across the condenser they are subjected to very high pressures. The greater resistance does not imply, however, that they should be wound with wire having a high resistance. In fact, such should not be the case, since a large value of ampere-turns is desirable. If copper wire is used in winding the electromagnets of the 'phones, a given resistance will of course mean many more turns and therefore more ampere-turns, than if wire having a higher specific resistance is employed.

Coils wound with insulated wire so arranged with a variable contact device as to have their inductance varied at will thruout a considerable range, are called *tuning coils* when used in connection with wireless receiving apparatus, and it is interesting to note that as the contact P shown in figure 2 is moved so as to reduce the number of turns, that is to decrease the inductance, at the same time the *resistance* of the circuit has also been decreased. That is, the decrease in inductance and of resistance must occur simultaneously in such a device. Reducing the number of turns reduces the actual length of wire in circuit.

The tuning might be effected by drawing an iron core in and out of a coil, which would give a very wide variation, but which would be sluggish in action, and of course would not vary the *ohmic* resistance connected in circuit. Another method of varying the inductance might be effected by constructing the coil of two portions, arranged to move with reference to each other. In such a case the variation is said to be effected by *mutual induction,* and the ohmic risistance of such apparatus is constant.

Harmonics.—A very interesting and instructive use of the tuning coil is in tuning the receiving circuit to respond loudly to the various *harmonics* of any *single* fundamental wave that is being sent out from a sending station. This may perhaps be best explained by considering the shape and composition of alternating-current waves or curves, and it is advisable to define just what is meant by an "alternating-current curve or wave." A true alternating pressure, current, or magnetic field is one which has exactly the same wave shape during each successive second, and one that is produced in accordance with a definite law: The very simplest alternating curve is the so-called *sine curve,* shown in figure 6. Such a curve is *constructed* by first drawing a circle, as shown at the left, and laying off on a horizontal straight line, the length of the circumference of the given circle. The length is shown as O X in the figure. Op is therefore one-half a circumference, Og one-fourth of a circumference. The sine curve may be constructed by first erecting at point g a vertical line equal in length to the radius of the circle, then at point n a vertical line equal to the line A^1 B, which is called the sine of the angle A^1 O A. In short, all the verticals erected on the horizontal base line represent the sines of corresponding angles about the center of the given circle. The dotted horizontal lines in figure 6 will give an idea as to the construction of the sine curve.

Now every true alternating wave of any shape whatever is made up of a certain number of these simple sine curves added together. The so-designated resultant curve in figure 7 is a true *alternating* curve, which is made up of three simple sine curves all starting at the zero point O, and all increasing in the vertical or positive direction. It may be noted that one of the component sine curves has the same frequency or wave length as the resultant curve. This sine curve may be called the *first harmonic.* Another component sine curve has three times the frequency, hence one-third the wave length of the resultant curve. This sine curve is called the *third harmonic.* The other component sine curve has five times the frequency and one-fifth the wave length of the resultant curve. The resultant curve is constructed by adding together *algebraically* the vertical heights of all three of the component sine curves at each point chosen. The small circles on the resultant curve indicate the points that were chosen in order to construct the particular curve.

By algebraical addition is meant that at any given point on the horizontal all vertical distances of the component sine curves extending below the horizontal must be subtracted from the vertical or the sum of the verticals extending above the horizontal at the same point. At points where all the component curves pass thru the horizontal datum line, there of course the *resultant curve* also passes thru the horizontal.

It is evident that a great variety of resultant curves could be constructed from three simple sine curves by simply varying the heights or amplitudes of these curves; or of only one of them. Every alternating wave of pressure if applied to any circuit will produce in the circuit an alternating curve of current that is also made up of component sine curves. It may, for example, be supposed that figure 7 denotes an alternating pressure E imprest on a circuit as shown in figure 5. By properly adjusting the movable contact P, resonance may be produced in the circuit with reference to the *third harmonic component* of the applied pressure, causing a maximum current in the receiving circuit having a frequency just *three times that of the fundamental* or resultant pressure and current. The predominating tone in the receiver has a pitch or frequency *three* times that of the fundamental or resultant curve. By still further adjustment of the variable inductance, the *fifth* harmonic may be made predominant. If an imprest pressure is made up of, say, fifteen harmonics and the tuning coil has sufficient range in adjustment, the *fifteenth* harmonic might be made the predominant one. As the frequency goes up the wave length inversely becomes lower. Thus the third harmonic has a frequency three times the fundamental, and a corresponding wave length of one-third that of the fundamental, etc.

Another interesting fact in connection with the matter of "tuning" may be alluded to here, that has a very important relation to music and musical instruments. Nearly every person can distinguish the musical tones given out by a violin from those given out by a cornet or a piano. That is, a tone having a definite pitch or frequency given out by a violin has a very different *quality* from the same tone or note (same frequency) given out by a piano or by a cornet. When all these instruments are tuned to, say, middle C, they each produce a note having the same frequency or the same pitch, but the shape of the sound waves sent out by each instrument is very different.

This may be illustrated diagramatically by figure 7 and figure 8. The resultant curve in figure 8 is made up of the sum of three sine waves as indicated, but has a very different shape from the resultant curve in figure 7.

The two resultant curves might have exactly the same wave length (distance from O to X), that is the same frequency, yet they will never be mistaken for one another. Two wireless waves having exactly the same frequency may readily be distinguished by an expert operator simply because of the characteristic of *quality.* It may be valuable to have devices that will tune not only for *pitch* but also for *quality.*

REGISTERED ATTORNEYS
LANCASTER & ALLWINE
255 OURAY BLD'G, WASHINGTON, D. C.

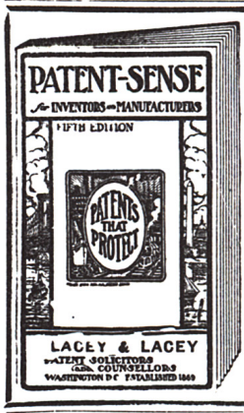
Don't Lose Your Rights

We publish forms called **"Evidence of Conception"** by which you can establish your rights before sending the invention to anyone. It is your best protection. We issue up-to-date bulletins of improvements wanted; aid inventors to promote their rights; render reliable opinions free of charge and secure valuable patents and trade-marks on reasonable terms. Personal service assured by our **Service Guarantee Contract. References:** 2nd National Bank, Washington, The John P Roth Packing Co., Cincinnati.

SIMPLY MAIL COUPON

LANCASTER & ALLWINE, 255 Ouray Bldg., Washington, D.C.
Send me free book "Inventions—Patenting and Promoting," Bulletins of Improvements Wanted and blank form "Evidence of Conception."

Name .....
Address .....



"The Book the Inventor KEEPS"

Worth more than all other patent books combined. FREE.

Write

LACEY & LACEY
131 Springer Bldg.
Washington, D. C.
Established 1869

Electricians ... Save Time, Money, Labor and Material by using our 98 Genuine Blue Print Drawings, containing all the latest diagrams and connections known in house wiring---every diagram and connection up-to-the-minute as used by first class electricians for wiring Bells, Burglar Alarms, Lights, Annunciators, Fire Alarms and Electric Gas Lighting. These drawings are bound in the form of a flexible book (9 x 12) for convenience in using on the job. Send for them, and if they don't make you more efficient as a wireman and save you many times their cost as a contractor, return them and money will be refunded---you can't afford to be without them. One Dollar post paid. Send for circulars on other sets of drawings.

PATENT SPECIALTY COMPANY
462 Sanchez Street San Francisco, Cal.

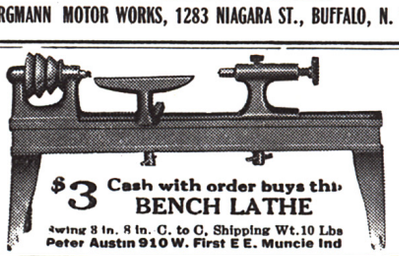
MAKE YOUR OWN GENERATOR!

We have a complete line of sturdy efficient generators and alternators from 100 to 1000 watts. We furnish these complete, or parts furnished ready to assemble with wire and instructions to wind. Send for catalogue.

ALL AT FACTORY PRICES.

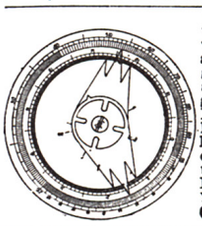
BERGMANN MOTOR WORKS, 1283 NIAGARA ST., BUFFALO, N. Y.

A BARGAIN



$3 Cash with order buys this BENCH LATHE
Swing 8 in. 8 in. C. to C. Shipping Wt. 10 Lbs
Peter Austin 910 W. First E E. Muncie Ind

ORDER NOW



THE MIDGET SLIDE RULE will add, subtract, multiply, divide; solve problems involving even and uneven roots and powers. Also gives the logarithms of numbers and the Sines and Cosines, Tangents and Cotangents of all angles. Its operation is very simple; quickly solves any mathematical problem. Durably made of metal. Adapted for shop and office use. Fits the Pocket. 3¼ inches diameter. Price with instructions.....$1.00
Your money back if you are not satisfied.
Gilson Slide Rule Co. Niles, Mich

27 YEARS THE ENEMY OF PAIN

AK

HEADACHE TABLETS

AK FAC-SIMILE AK FAC-SIMILE

FOR HEADACHES, NEURALGIAS, LAGRIPPE, COLDS, WOMEN'S ACHES AND ILLS

10 CENTS

ASK YOUR DRUGGIST FOR "A-K" TABLETS

THE ANTIKAMNIA CHEMICAL COMPANY, ST. LOUIS

25 CENTS

Wireless Taught By Mail

DRAFTED MEN NEED THIS

for entering the SIGNAL or AVIATION BRANCH of the army when being called to the Cantonment.

SPECIAL WAR RATES

Send stamp for catalog giving facts. Resident classes open the entire year.

NATIONAL RADIO SCHOOL, 14th & U Sts., N. W., Washington, D. C.

Navy Needs 1000 Operators Now

TYPEWRITER SENSATION

$3.00 a Month Buys Visible Writing L. C. Smith

Model No. 5

Perfect machines only of standard size with keyboard of standard universal arrangement—has Backspacer—Tabulator—two color ribbon—Ball Bearing construction—every operating convenience. Five Days' Free Trial. Fully guaranteed. Catalog and special price sent free.

H. A. SMITH, 738-231 North Wells Street, CHICAGO, ILLINOIS

THE HOW AND WHY OF RADIO APPARATUS.

(*Continued from page* 30)

a potentiometer resistance. The sealed-point containing the fine Wollaston wire is made positive. No adjustment is necessary with this detector. Two dry cells are used, a switch being provided as shown. The electrolytic detector is extremely sensitive and can be made up in a few minutes in emergency. It does not "jar out."

The *Bare-Point Electrolytic Detector* has been the subject of much discussion among radio men as to who really was the basic inventor of it. But most writers of the day give credit, jointly, to Dr. Michael I. Pupin (1899), Professor Reginald A. Fessenden (1903) and W. Schloemilch (1903).

The action of this detector is based upon the fact that if an extremely fine platinum wire, measuring a few ten-thousandths of an inch in diameter is allowed to partially immerse its extremity in an acid solution (such as one composed of five parts water and one part nitric acid) that an incoming Hertzian wave current will tend to arrest the strong polarization (the production of fine gas bubbles) set up about the fine platinum wire, which is usually made the anode in the battery circuit. Further, the electrolytic detector has been found by Professor G. W. Pierce to act as a rectifier and that the inherent action is also based on polarization capacity at the electrodes as first described by Pupin in 1899. Dr. L. W. Austin and others have found that the fine platinum wire may be positive or negative for feeble oscillations with equal results. The acid solution is contained in a glass or carbon or zinc cup, and this acts as the cathode in the battery circuit. This detector possesses the function of acting as its own battery when a carbon or zinc cup is used, as this forms a miniature cell—carbon (or zinc) acid, platinum. This inherent battery action was intensified considerably by using a special amalgam in the acid solution in a detector of this class developed by H. Gernsback several years ago. The self-excited electrolytic detector has never been found (Pierce) to be as satisfactory as the externally excited one for feeble signals.

The operation of the sealed-point type ("Radioson") is the same as in the bare-point electrolytic type of detector and a battery of two dry cells is used with it, together with a pair of high resistance telephone receivers and having the battery potential preferably regulated by means of a high resistance potentiometer.

Science, the Wonders of Chemical and Electrical Phenomena

The last news of recent military inventions, all kinds of fine articles on how to construct things of a chemical and electrical nature, hard to get formulas, interesting experiments, curious things from the World of Science, Stamps, Minerals, etc. A Question Box and a Round table Department make this magazine just chuck full of interest from cover to cover. A Complete Course in General Analysis written by the Dean of the United States College of Chemistry, is now running in the Current numbers. *You cannot afford to be without this magazine.*

SPECIAL LIMITED OFFER

With the appearance of this ad, our offer of six months for 25 cents is closed, but we have something better. Just think of getting **a full year subscription** to this wonderful Magazine for **only 75 cents, coin. No stamps will be accepted. 12 big issues, fully illustrated. Send in your subscription to-day,** before this offer is **withdrawn.**

ZENITH CHEMICAL LABORATORIES, Printers & Publishers DULUTH, MINN.

The advantage of this type of electrolytic detector is that the acid is sealed in, consequently does not spill or evaporate.

The *tikker* is used a great deal in translating undamped signals. It was devised by Poulsen and employs a small vibrator or rotary contact interrupter as shown at Fig. 4. No detector of the ordinary kind is used. The condenser connected across the 'phones should have about .02 m. f. capacity. It can be of the paper and tinfoil type.

The *Fleming Valve Detector* of Hertzian oscillations (Fig. 5) is based upon the principle that if we have a hot or incandescent electrode, and also a cold electrode, both mounted within an evacuated glass chamber, a rectifying action will be created, i. e., that negative electrical charges, such as those from a battery of 30 to 40 volts or even less, can pass from the hot filament to the cold electrode, but not vice versa. In the Fleming Valve the cold electrode takes the form of a metal cylinder surrounding the incandescent filament. This arrangement acts as an electrical valve for oscillating or alternating currents of any frequency. The space between the cold cylinder and the hot filament is therefore said to possess unilateral conductivity. The Fleming Valve possesses a fairly high sensitivity; it is used with a pair of high resistance head 'phones, a suitable battery and auxiliary regulating apparatus. The wireless receiving phenomenon occurring will be evident from the foregoing and is, in a sense, of a rectifying nature similar to that possest by the mineral detectors.

Since the Fleming valve detector has a very high resistance, the condenser C should be very small, the inductance L relatively large, and the telephone receivers wound to a very high resistance, say 4,000 to 5,000 ohms, recommends Dr. W. H. Eccles. A peculiar fact about this detector is that its action is interfered with if the glass of the bulb becomes statically charged; hence the bulb is surrounded by a copper gauze screen which is earthed by connecting it to the battery supplying the lamp filament.

The *Audion Detector* (Fig. 6) employs three distinct electrodes as shown, viz., a filament—a grid—and a wing or plate. The grid, composed of a wire member as indicated, is placed between the filament and wing. The oscillations when they pass thru the Audion detector are subjected to a similar action to that occurring in the Fleming Valve; that is, they are rectified, but in so doing they are claimed to also effect a relay action with respect to a high voltage battery of 40 to 50 volts potential, connected to a pair of high resistance telephone receivers in the *wing* circuit. Thus, with the Audion it is seen that, owing to the suggested relay action inherent in its operation, it is quite possible and practical to have such an action occurring of considerable magnitude; that is, the ratio between the amount of energy passing into the Audion from the antenna circuit, and the amount of energy controlled by the relay or *trigger* action in the high voltage 'phone circuit may be quite large.

There was, for a number of years, a great controversy on between the de Forest and the Marconi experts as to the validity of the Audion patents. This matter was discust in the November, 1916, and also in the December, 1916, issues of this journal, and those interested had best read both of these excellent articles as well as a very exhaustive article explaining the electronic action of the Audion which appeared in the August, 1916, issue of THE ELECTRICAL EXPERIMENTER.

The Marconi *magnetic detector* is a battery-less type much used on shipboard. It is illustrated at Fig. 7. The detector illustrated is the well-known Rutherford-Marconi *Magnetic Detector*. This instrument operates on a very unique principle, viz., that of the reduction in any hysteresis effect occurring in an iron core, when this core is subjected to the effect of a Hertzian wave current passing thru the receiving circuit, according to the researches of C. Maurain. The complete detector is so arranged that a band of fine insulated iron wires constantly revolve about two rotary drums, driven by a spring or electric motor, and a pronounced hysteresis or magnetic frictional effect is produced in that section of the traveling iron wire band directly under the poles of a set of steel magnets mounted as shown. At this point there is also placed a small transformer containing a primary and secondary coil. Thru the primary coil is past the aerial current induced by the incoming electro-magnetic wave, while to the secondary coil is connected a pair of low resistance telephone receivers.

It is evident, from the foregoing explanation, that at every incoming signal there will be a sound heard in the 'phones as the Hertzian wave currents flowing around the primary coil cause partial cessations or reductions in the hysteresis effect produced in the moving iron wire band.

One of the most important circuits used with the Audion valve is that using one valve for producing an oscillating condition. This is shown in diagram Fig. 8.

Delivered TO YOU FREE

No other concern will offer you such values or such terms. Make your choice from **44 styles**

colors and sizes in the famous **"Ranger"** line of bicycles *freight prepaid* to your town. Sent on approval for **30 DAYS' FREE TRIAL.** From our new big catalog select the particular style of **RANGER** bicycle you desire. We pay return charges if you decide not to keep it. You get one month riding test at our expense. **LOW FACTORY PRICES** direct to you from the largest, oldest and most successful bicycle concern in the country.

TIRES Lamps, Horns and parts for all bicycles at *half usual prices.*

Send No Money but write today for this big free catalog, also full particulars of new *30-day free trial offer.* Do not buy until you receive it. *WRITE NOW.*

Electric Lighted RANGER Motorbike

We want a Rider Agent in Every Neighborhood

MEAD CYCLE COMPANY Dept S-107, Chicago

FREE TRIAL

We ship the famous Oliver Typewriter—brand new—direct from the factory to you for free trial.

If you want to own it, pay us at the rate of $3 per month. Or return it. You are your own salesman and save $51 this new way. Before our direct-to-you plan the Oliver price was $100, now it is $49. All the saving comes from our economical distribution. Write for details of plan and our new catalog. Then you may have an Oliver for 5 days free trial. Write today for details.

The Oliver Typewriter Co.
675 Oliver Typewriter Building
Chicago, Ill.

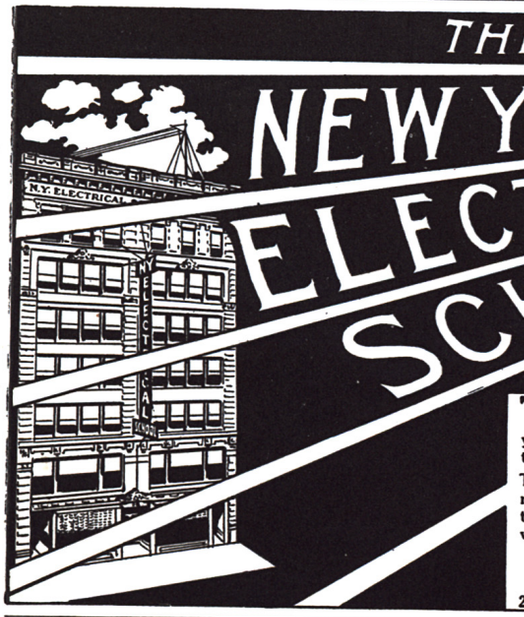
MECHANICALLY RIGHT—A REAL LATHE

A Regular lathe, not a toy

Swing 4 inches, 11 inches between centers. 17 inches total length. Net weight 9 lbs. Shipping weight 13 lbs. The bed of this lathe is machined. Workmanship is first class throughout. Lathe comes equipped with wood turning chuck. Lathe can be fitted with 3 inch face plate and drill chuck as special equipment. Order one today. Price $4.50 cash with order.

SYPHER MFG. CO., DEPT. C, TOLEDO, OHIO

THE NEW YORK ELECTRICAL SCHOOL



THE N. Y. ELECTRICAL SCHOOL is the pioneer and premier school of the "Learn by Doing" method. When you have completed this Course you shall be fully qualified to handle ALL branches of Electrical industry.

The equipment of this School is unequalled and up-to-the-minute. No preparation needed to become a "learner" in this school. You can start to learn on any day of any week throughout the whole year. Send for catalogue.

New York Electrical School

29 West 17th Street New York City

SEND PICTURES BY ELECTRICITY

This latest sensation in electrical advancement—marvel of today, necessity of tomorrow, affords wonderful entertainment. Affords instruction in the coming science. You can send pictures of your friends by electricity over telegraph wires or by wireless. Picture in this advertisement was sent and received by this system. Electrical experts and scientists have declared the Leishman Electrical Picture Transmission System is the marvel of the age. See article December Issue

Write today for descriptive folder

L. J. LEISHMAN COMPANY Dept.T, Ogden, Utah

WITH this new Electrical Wonder you get the pleasant effect of a massage and a shave at the same time. This razor is on the market and we are shipping all points in the United States and South America.

This device can be used without electricity like the ordinary safety razors, but is supposed to be used with alternating current. The blade moves 7200 times per minute and actually cuts the hair without pulling. Price $10.00.

Vibrating Electric Razor Co., Omaha, Neb.

35 MILES PER HOUR

Is Record Of This Car

Built by a boy from Junior parts furnished by us. Any boy can build this car. Parts very cheap. Send 26 cents for blue prints and price list of parts showing how to build this speedy little car.

SYPHER MFG. CO.
156 Warren Street
TOLEDO, OHIO

Old Kentucky, Home Grown, Natural Leaf Tobacco

IN HANDS Cool, Sweet, Juicy, Mellow and Mild—THE IDEAL TOBACCO

The Kind All Real Tobacco Users Like

Orlie Nimmo, Camp Lee, Medical Department, Petersburg, Va., says: "Please ship me five pounds of Old Home Spun. I had rather have your Tobacco than all the manufactured tobacco in the world."

If you will try my OLD KENTUCKY HOME SPUN you will be pleased and will write a testimonial equal to the above. Kentucky has the best.

Specially selected from my own crop—One Pound 60 cents: Five or more Pounds, 50 cents per pound. Small sample, 25 cents.

RUBLE McNEILL, Boaz, Kentucky

Magnets, big, powerful, permanent; lift about 3 lbs. Educational, useful. Sent parcel post $1.00 each.

GENERATORS

We also have a number of high grade **Holtzer Cabot Hand Generators** which we will dispose of at bargain prices. Give up to 110 volts, A. C. You can make direct and run by pulley if desired. Special price $3.00 each. No catalog.

WATSON ELECTRIC CO.

124 S. Michigan Ave., Chicago

WIRELESS

The Government now urgently needs radio men for the Naval Reserve, Aviation and Signal Corps. Our Special short code courses, Day or Evening, prepares you quickly for Government Service. Students admitted any time. Send for LATEST prospectus, just out.

EASTERN RADIO INSTITUTE

899 B Boylston St., Boston, Mass.

FREE BOOK ON AVIATION

Learn of the great opportunities in this new $1,000,000,000 industry. Thousands of men needed. Learn by mail—free book tells how. Write at once.

NATIONAL AERO INSTITUTE, Dept 7445 Norton Bldg., Chicago

The circuit as here shown has been successfully used for several years by experimenters and others without the tickler coils, these being a new wrinkle, which tend to stabilize the oscillating conditions, once they are set up by tuning the various inductances and capacities. The condenser capacities are given. It is suitable for intercepting damped as well as undamped signals. The inductances are of the following dimensions:—primary of loose coupler is 10 by 5 inches, wound with No. 22 S. S. wire; the secondary is 10 by 4¼ inches, wound with No. 28 S. S. wire; the secondary loading coil SL measures 22 by 3½ inches with one layer of No. 30 S. S. wire, while the wing inductance WI is the same size with a winding of one layer of No. 30 S. S. magnet wire.

Beat reception with Audion amplifier connections has been accomplisht with great success by Prof. A. Hoyt Taylor in the radio laboratory at the University of North Dakota. In his circuit, which has proved sensitive enough to pick up the German stations 4,300 miles away; and shown diagramatically at Fig. 9, use is made of two Audions, Nos. 1 and 2, both of which are chosen so as to be capable of generating oscillations. The 1 to 1 auto-transformer M (9,000 ohms) may be made from a spark coil secondary or a couple of them, thru which a soft iron wire core is past, and the whole sealed up in a tight cabinet filled with molten paraffin wax or sealing compound. This inductance M, allows current from the 35-volt battery to pass but stops high frequency or pulsatory current.

The stopping condensers SC, should be small, the second one being of about 0.5 billifarad (one billifarad = 1 millimicrofarad or 10^{-9} farad). The variable capacity C should not be above 4 billifarads, thus permitting L to be large. For very long waves an aerial with a length of 800 ft., was used; its average height was 75 ft., and its capacity 0.013 m. f. The circuit LC is slightly mistuned from the signals and the Audion filament heated somewhat above normal, when working this circuit. The *beat* note is thus greatly amplified when it reaches the high resistance telephone T. Prof. Taylor has done excellent work with this arrangement, hearing the German stations at Nauen (10,000 meters wave length). Eilvese (7,800 meters w. l.) and both the arc and the spark signals sent out from the station at Honolulu. T. H.

(*To be continued*)

LOCATING AND DESTROYING "SUBS" WITH MAGNETS.

(*Continued from page* 6)

In operation, a fleet of ships are supposed to travel abreast towing their respective electro-magnets, and the moment any one of these magnets come in the immediate vicinity of a submerged metallic object, it will be attracted to such an object. The magnet cables are then payed out to prevent any possibility of pulling the magnet from the object and in the meantime the ship may be brought to a standstill. In some instances the force of the powerful electro-magnet may be great enough to permit raising mines, by simply winding up the cables controlling the magnet and boom. In most cases, however, a bomb, which may itself be fitted with a self-contained magnet, and exciting means such as a battery, would be lowered to destroy the entrapt body. The inventor mentions that before exploding the bomb that the vessel should move off a safe distance to prevent injury to her hull, due to the terrific concussive waves transmitted by the explosion thru the water for a distance of several hundred feet at least, in most instances.

If the bomb lowered into the water for the purpose of destroying the enemy submarine or mine, is provided with a self-contained electro-magnet and battery as outlined above, then it is a simple matter for the vessel liberating it to steam away a considerable distance before the time fuse on the bomb detonates it.

NEW SPY AND SCIENTIFIC MOVIES.

(*Continued from page* 8)

as the subject as a proof of his love and faith. Overhearing her acceptance of Leslie's proposal, the now half-crazed Durand believes the time has come when he can execute his scheme of vengeance.

Before a large crowd of scientists and famous surgeons, Dr. Leslie is inoculated. Durand, stealing the key to the cabinet in which the precious serum is kept, destroys it, but in so doing inoculates himself by contact with a test tube containing the poison germs. The time arrives for Laurel to administer the serum and she discovers the theft from the cabinet. After trying frantically to get in communication with the Zoo, she dispatches her chauffeur with instructions to bring back the only other specimen of mascarine turtle in existence at all costs. Confronting Durand, she accuses him of the theft and he confesses. After an agonizing delay, the chauffeur returns with the turtle and Laurel is able to save Leslie from a terrible death.

Meanwhile, her husband arouses from a drunken stupor into which he has fallen and finds himself locked in a small room of the laboratory. By the time he is able to attract the attention of Laurel he has become seriously ill. Leslie insists that the girl give Durand the two remaining injections of the serum and Laurel is confronted with the choice of risking the life of the man she loves or saving his would-be murderer. Due to the fine vitality of the young physician, he fights a splendid battle with death and recovers, while Durand, whose health has been sapt by indiscretions of all kinds, dies. After the scathing fires of fate to which she has been subjected, Laurel finally emerges happy in the love of young Leslie and together they plan a life devoted to the serving of humanity and the true affection which they now realize they have always borne for each other.

YANKEE CODE NOT SO "BLOEDSINNIG."

(*Continued from page* 7)

it never materialized into anything big. It is really wonderful tho, to think that he could transmit speech a distance of one-half mile by simple induction. He used elevated wires connected at their upper ends to large condensers and at their lower ends to the earth. Thomas A. Edison also experimented with the electrostatic inductive system of wireless between a moving train and a "paralleling circuit" strung along the track on poles. The roof of the car was metal covered and the telephone apparatus was connected to it as well as to earth thru the car wheels. Success was attained with this system but it never became a commercial proposition.

ELECTRICITY AND METAL COATED SEEDS BOOST CROPS.

(*Continued from page* 9)

High frequency electricity produces a definite vibratory impulse that is doubtless the cardinal factor in increasing plant growth. The idea that the electricity primarily heats the ground is not a correct one. The heating may be incidental to other results, and

in wet, cool weather may serve to counteract inclement weather conditions. This, however, is rather incidental to the major process.

"That it enriches the plant life and stimulates the quality of the crop," says the inventor, "I have proved to my own critical satisfaction. The sugar beets grown by the electrical method were so much more succulent and sugar laden than the other variety that, altho only six feet separated two fields, the *electrically grown plants were the choice* of even that sugar-loving beetle, the 'astor bug.' When the superior quality of the plants makes even pests discriminate, the method has furnished at least its first credentials."

"Do you think the electric idea might be adapted to the extermination of insect pests?"

"Certain insects are susceptible to the electric vibration even in its present form," he replied. "The electric influence has been known to force worms out of the ground. I have little doubt that the ramifications of the idea will see electricity used not only to foster plant growth but to protect the crops from insect enemies."

It is unqualifiedly affirmed by those interested in the tests that the electrical treatment of the seeds, roots and soil increases production so markedly that the beneficent effect of the treatment cannot be gainsaid. Adjoining fields of corn and sugar beets, planted at the same time as those specially treated with the electrode current diffusers, showed growth and production only one-half or three-fifths as great.

The result of tests in electrifying corn and sugar beets on eleven acres of Illinois land, as announced by R. D. McCreery, follow:

Electrified Corn

Came up three to four days sooner than ordinary corn.

Increased the germination 31% to 39%.

Increased the rapidity of growth 30% to 50%.

Increased the volume of stalks 33% to 40%.

Increased the corn production 30% to 40%.

Increased the money value of crops per acre $25 to $35.

Electrified Sugar Beets

Increased the production in weight volume 15%.

Increased the sugar content 14%.

Increased the money value of crop per acre over $50.

The cost was less than 50c per acre for current and metallically coating the seed. Net cost of apparatus installed was less than $200.

A TIGHT SQUEEZE FOR UNCLE GEORGE.

(*Continued from page* 39)

ing that we leave the Temple of Thespis by the back door on Mason Street, it being handier to the car—also less handy to the public eye.

My invention consisted of allying to the projection business what highbrows call a "sister art"; and my acquaintance with this sister, a modest violet now to be dragged into the garish light that beats upon the stage, came about in the following way:

The Riverside Press, in Cambridge, my native "burg," was a favorite prowling-ground for us kids. If you were good, and didn't bother any, you could stand and watch one of the big presses squeeze a sheet of paper, haul it out covered with book-pages, and spank it down on top of a pile of previously printed ones, with an almost human emphasis that reminded you of the "There, thank goodness!" air of a woman ironing the last piece in the wash.

Sometimes the printer would give you a sheet that had got spoiled by going in crooked, and you could read the middle eight pages of a detective story for nothing—though of course a detective story with both the crime and the detection extracted is very low in percentage of thrill.

Besides the printing, there were a hundred other processes to see, and each was so interesting that you never got very far in a single visit to the Press. Before you knew it, the whistle would blow, the machinery would slow down and stop, and the workman would thank you for your kind attention and depart to see if he could find a clean place on the roller-towel.

One day, as I was exploring this palace of marvels, I came upon a workman over in a corner by himself, without a single power-machine, and with only a tank and a lot of bottles. He was *marbling paper,* and the barbaric richness of his product was enough to make you dream you dwelt in marble halls, as the song goes.

On the surface of his tank of water he sprinkled drops of brilliant-colored oils—red, green, yellow, brown, the vividest tints in the tintery. Each drop, as it struck the water, floated and spread out in a perfect circle. Then, as he combed or swirled the surface with the simplest tools, the colored circles drew out, zigzagged, spiralled, scalloped, and finally came to rest in the intricate design of variegated marble. On this, a sheet of paper was gently let down, the oils adhered in an instant, and the design, as intangible as a bubble, was fixt forever.

That was the invention which popt into my head at the theater—to project on the stage these magnificent colored designs, shifting every instant like the figures in a kaleidoscope.

The drawing speaks for itself—the invention's middle name was *Simplicity.* The tank, for blending the colors, was to be of glass. The beam from a stereopticon, condensed by lenses, was to cast upward an image of the colored film, which a mirror would then reflect into a horizontal direction to flood the stage. The stirring of the colors was to be done by a stream of air thru a blowpipe, to keep the cause of the changes invisible.

Fortune was mine—again. If the theatrical world would stand for that crude blue-and-star effect, unworthy of the inventive powers of a semi-intelligent janitor, what sort of transports would it throw at sight of my dizzying spectacle? Answer: once seen, it would be universally demanded. With the monopoly of the business in my grasp, I felt that I must be firm with Kiralfy, the Spectacle King of those days. He would probably try to get, for almost nothing, my invention which was destined to lift his shows absolutely out of the commonplace.

The experiment had to be tried out, of course, if only for gloating purposes, and fortunately I had a small magic-lantern as so much toward the equipment. I made a tank from a window-pane surrounded by a wall of putty; and the lone workman at the Press, out of regard for Science (also, to some extent, for his own peace of mind) contributed an assortment of his liveliest pigments.

My lantern being lighted, and everything ready for the test, I scattered a few drops of the various oils on the water in my tank, blew gently across the surface thru a straw, and was delighted to see the colored discs stretch out, mingle in bands like a Roman sash, or form gorgeous designs varied from moment to moment, all projected in a magnified form on the white-washed cellar wall.

So far, I had got by without exciting the

RADIO OPERATORS NEEDED

Government Service Merchant Marine

Special course for men subject to draft

Complete concentrated course under experienced teachers

SETTING UP MACHINE GUNS

Theory & Practice taught by experts

Complete Equipment—Low Rates—

Individual Instructions—

Dormitories

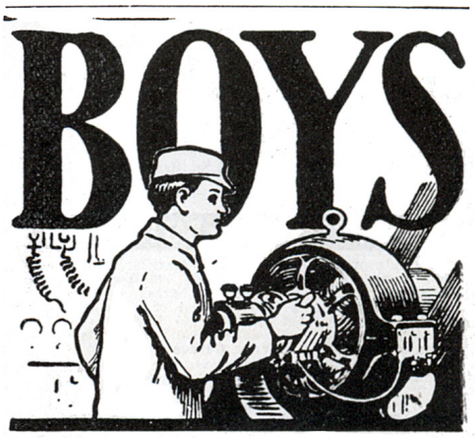
START TODAY

Write for Illustrated Booklet

Y. M. C. A. RADIO SCHOOL

145 E. 86th Street, New York, N. Y.

BEST RADIO SCHOOL IN NEW YORK



Big Money in Electricity

The electrical industries offer wonderful opportunities to boys with a liking for Electricity. The salaries paid to trained men are large, promotion comes rapidly and, best of all, the work is fascinating.

The discovery and development of new lines (such as wireless telegraphy and telephony), from time to time, promise attractive and paying fields to those who wish to specialize. The *will to do* and *Special Training* will bring success to *you.*

The International Correspondence Schools can help you to become an expert in electrical work, no matter what branch you like best. Thousands of young men have already won success through I. C. S. help. You can do as well as anybody, *if you try.* Everything is made so clear that you can learn in your spare time, regardless of where you live or what your work. No books to buy.

There's big money in Electricity. Get after it by marking and mailing the Coupon today. *Finding out costs you nothing.*

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS

Box 5380, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BOOKKEEPER
☐ MECHANICAL ENGINEER	☐ Stenographer and Typist
☐ Mechanical Draftsman	☐ Cert. Pub. Accountant
☐ Machine Shop Practice	☐ Railway Accountant
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ Common School Subjects
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ Metallurgist or Prospector	☐ Railway Mail Clerk
☐ STATIONARY ENGINEER	☐ Textile Overseer or Supt.
☐ ARCHITECT	☐ AGRICULTURE ☐ Spanish
☐ Architectural Draftsman	☐ Navigator ☐ German
☐ PLUMBING AND HEATING	☐ Poultry Raising ☐ French
☐ Sheet Metal Worker	☐ Automobiles ☐ Italian

Name _____

Present Occupation _____

Street and No. _____

City _____ State _____

Build Your Own PHONOGRAPH

It's Easy With Our Help

A few hours interesting work saves many dollars and gives you a machine exactly to suit your ideals We furnish motors, tone arms, case material, blue prints and full instructions. Plays any record. You can make fine profit building phonographs for your friends.

SAVE OVER HALF

Write Today for Our Free Blue Print Offer. Agents wanted for our ready built Choraleons

CHORALEON CO.

705 Monger Bldg., Elkhart, Ind.

$1.75

5 YEAR GUARANTEE

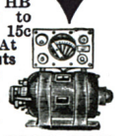
Railroad Style

To advertise our business, we will send this elegant R. R. style watch by mail for **ONLY $1.75.** Gentlemen's size, full nickel silver plated case, locomotive on dial, lever escapement, stem wind and stem set, a perfect timekeeper and fully guaranteed for 5 years. Send this advertisement to us with **$1.75** and watch will be sent by mail post paid. Satisfaction guaranteed or money refunded. Send $1.75 today. Address

R. E. CHALMERS & CO., 538 So. Dearborn St., CHICAGO.

BIG PROFITS with this BATTERY CHARGER

Hundreds of garage owners are clearing $40 to $60 profit every month with this 500-Watt HB quick-charging equipment. Recharges one to seven batteries at a time, at cost of about 15c per battery. Autoist pays 75c to $1.50. At least $4.50 profit each capacity run. **$15 Puts This Money-Maker in Your Garage.** Balance in nine monthly payments of $20 each. Earnings will quickly pay for machine. Every outfit fully guaranteed. Tear out this ad and send with name for full particulars.



HOBART BROS. CO., :: BOX 5E, TROY, OHIO

GET ON THE VAUDEVILLE STAGE

I tell you how! Fascinating profession for either sex. Big salaries. Experience unnecessary. Splendid engagements always waiting. Opportunity for travel. Theatrical agents and authorities endorse my methods. Thirty years' experience as manager and performer. Illustrated book "All About Vaudeville" sent FREE. Frederic La Delle, Sta. 246 Jackson, Mich.

GET this Car FREE

Learn every branch of the Automobile Business, and get this car free while learning. We send first lesson free to those answering this ad. Great opportunity. Write today for special inducements. Address

C.A. Coey, President Coey College of Motoring Coey Building 2069 Wabash Av. Chicago

EXPERIMENTER'S LIBRARY - $2.85

Comprising Philip E. Edelman's "Experiments," $1.50, and "Experimental Wireless Stations," $1.50, (528 pp., New Eds.). You need these handsomely illustrated cloth books on just what you want in electricity, radio, chemistry, laboratory, mechanics, etc. Order now.

PHILIP EDELMAN, Pub., 1802 Hague Ave. St. Paul, Minn.

TYPEWRITERS

ALL MAKES. SAVE $25 TO $50 on rebuilt by the well-known "Young Process." Sold for low cash—installment or rented Rental applies on purchase price. Write for full details and guarantee. Free trial.

Young Typewriter Co., Dept. 651, Chicago

Print Your Own Cards, circulars, label, book, paper. $6. PRESS. Larger $20. Rotary $70. Save money. Print for others, big profit. All easy, rules sent. Write factory for catalog presses, TYPE, paper, cards.

THE PRESS CO., D-47 Meriden, Conn.

Learn Watchwork, Jewelrywork and Engraving. A fine trade commanding a good salary, and your services are always in demand. Address HOROLOGICAL Department, Bradley Institute, Peoria, Ill., for our latest catalog

FREE BOOK ON AVIATION

Learn of the great opportunities in this new $1,000,000,000 industry. Thousands of men needed Learn by mail—free book tells how. Write at once.

NATIONAL AERO INSTITUTE, Dept 7445 Marton Bldg., Chicago

family's suspicion of my dealings with the Powers of Darkness, as the magic-lantern was a familiar household object, and I was always messing around with something or other. I was about ready to run away to New York and confer my invention on the waiting public when the enterprise was wrecked—yes, sir, absolutely wrecked—simply by extending the experiment to a wholly unnecessary realism.

At that time, my particular pal and partner in undertakings of magnitude was "Gimp" Skillings, who lived next door. The Skillingses were easy-going people, and Gimp was little hampered by restrictions; in fact, he lived the wild, free life of a man of the world, so far as it could be done on an income exprest in marbles and rusty nails, rather than money.

"Gimp," of course, knew all about the theater; and while his approval of my invention was enough to guarantee it in the winning class, he strongly advised adding to our equipment a model stage. It seemed superfluous to me, but "Gimp" was keen for it, claiming that Mr. Kiralfy always required a working model before signing a contract; in fact, it was the invariable custom in theatrical circles.

That settled it, so we went to work and built a miniature stage out of a soap-box, painted with a *proscenium arch* and *footlights,* and hung with a series of cheesecloth curtains to reproduce the sensational finale of "The Black Crook." A small doll of my sister's consented to assume the rôle of the Fairy Queen—standing, with white robe, wings and star-tipt wand, behind the innermost curtain, to be revealed at the critical moment, rescue the lovers, and swat the "Crook" into his flaming pit.

The full-dress rehearsal came off at 4 o'clock one Saturday afternoon. It was a winter day, and cloudy at that, so it was practically pitch-dark in the cellar, which of course was just what we wanted.

Gimp worked the *stage properties* while I handled the *light.* As I started the colors going, he raised the cheesecloth curtains one by one, declaiming the impressive climax of our favorite playlet—full of thee's and thou's, with here and there a forsooth or two to give it tone.

As the last curtain went up, exposing the doll in her fairy-queen rig, "Gimp" turned on the full force of eloquence in the thrilling speech: *"Fear not, weak mortals, I will protect thee henceforth. And THOU, O Black Crook, down, down with thee to the nethermost depths, and the torments of the damned."* Whereupon "Gimp" opened the furnace door and threw in a lump of coal to represent the "Crook."

Now "damned" was a word very much out of favor in those times. Its use was considered such extremely bad form that when father met with it in reading the Bible aloud he mumbled it apologetically, as tho its presence even there had been due to a slip on someone's part. So, when "Gimp" damned the "Crook" I glanced around involuntarily, as you will at a noise in a haunted house, even if you don't believe in ghosts.

One glance, and my blood froze solid. Out of that part of the dense darkness which I knew was the cellar doorway a face stood forth—only a face, no body attached—illuminated by the red glare from the furnace. The face was father's!

It looked as tho our melodrama had got too good a start, and was about to unfold a new act on its own hook. "Gimp" and I shrank three sizes, and waited breathlessly. "Breathless" is often used to describe suspense, but it's generally an overstatement. Not in this case.

Father opened up his performance with a "sight act." Advancing on our theatrical equipment, he seized "Gimp's" stage in one hand and my pet apparatus in the other, and stuffed them into the furnace, where the "ex-Crook," with the rest of the coal, was glowing balefully. Then he cleared his throat for the "speaking part."

With a crime of such unusual juiciness to handle, it was up to father to make a record. He did.

He pounded like Elijah on the Prophets of Baal, but not on me—on "Gimp"; and even on "Gimp" he lit only in passing, to denounce his supposed offence of enticing me to sin. Thru "Gimp" he was seizing the opportunity for his first good healthy crack at the "Skillings" family. It was bewildering to hear the vial of his wrath go bouncing down the field like a hot liner thru the smarting hands of second base and shortstop.

It was a three-bagger for the "Skillingses," believe me. All the disapproval which he and mother had been nursing against their next-door neighbors since they first moved on to the street, ten years before, tried to get off father's chest in a single package—the whole tale of their domestic shortcomings, from their soiled attic windows to their undisciplined, playmate-contaminating child. Father was not usually a rapid speaker, but this time you could almost hear the brakes squeak as his high-powered sentences fought each other for a place in the line.

For my part, I knew this wasn't letting me out. Enticement was no excuse in our family, and I was scheduled later to "get mine" with all the then modern embellishments; but there was almost cheerfulness in the thought that Uncle George was escaping the taint of a cruel, if merited, suspicion. "Gimp," as the scapegoat, was being somewhat roughly handled, to be sure, but "Gimp's" injuries could be settled for. If I could only keep *him* quiet! The outraged "Gimp," at every chance, was sputtering forth such preludes as "It wasn't——" "Say, look here——" and, most perilous of all, "It was his Unc'——" At every sputter I pinched him forcefully in the darkness—also in the leg—hissing, "Cheese it!" "Let it go!" "I'll make it all right with you!" and other soothing sounds, till finally I got him under control.

The climax of father's speech came in a detailed list of the "Skillingses'" failings. He tried to use words of one syllable, so "Gimp" could take it home with him, but he had to give that up; it was no job for verbal flivvers. As it progrest, one learned that the family's denuded and broken-fenced yard excited not pity, but contempt; that their cornet-playing boarder was a nuisance which called for the attention of the Grand Jury; while as to their persistent and pestiferous practise of purloining their neighbors' property under the subterfuge of borrowing, it was enough——

It *was* enough. Just then his foot stubbed on a gloom-hidden object which clanked softly at him, like a watchful friend in a threatened predicament whispering, "Sst, Bill!" It was the "Skillingses'" lawnmower, borrowed late in the season and forgotten. Father's discourse came to a sudden end. He wasn't taken aback, you understand; he only happened to be seized with a coughing spell he was subject to in moments of excitement. He fled upstairs for relief. Uncle George was saved, and "Gimp" applied himself to estimating his damages.

That was as near as I got to the stage, for my great invention remained in abeyance, owing to unfavorable business conditions. "The Black Crook" and its successors, "Superba," "Babes in the Wood," and many other aids to moral indigestion, ran their course and died, their proprietors never suspecting that they'd actually mist the one "real opportunity" of their lives.

"SHOOTING" ELECTRICAL TROUBLES ON AUTOMOBILES.

(*Continued from page* 38)

caused by the burning of the contacts when the switch is allowed to open slowly and arc. Dismantle the switch and sandpaper all parts clean and replace. Should the switch test O. K. the trouble will then be found in the wiring, it being either a short-circuit or a broken wire.

In case the test in Fig. 7 shows no decided drop at the motor terminals over that at the battery, with the starter on, the trouble lies in the motor. This may be due to a number of causes as follows:

Motor brushes may be short, stuck in the holder, of a poor grade or improperly fitted to the commutator. Weak brush springs, dirty commutator or rough commutator.

High mica, low segments, loose pig-tail connection to the brushes, loose or poorly soldered connections, open field or armature.

Open circuits in the armature and low segments will be indicated by the burning of a few segments of the commutator.

Most of the above troubles will be detected by an examination of the parts mentioned and corrected, always using fine sandpaper for cleaning the commutator or brushes. To fit the brushes to the commutator wrap a piece of smooth, fine sand paper around the commutator and with the brushes pressing on it, turn the armature by hand till they are ground to the same curvature as the commutator.

A grounded armature can be detected by using the 'phone test as shown in Fig. 14. A click in the 'phones indicating a ground.

The work of removing the ground should be left to an experienced man unless you are well acquainted with armature work. The usual practise is to disconnect the leads from the commutator at diametrically opposite points and then test each half of the winding. The winding is split again and tested till the grounded coil is isolated. The coil is then raised from the core and the ground found by examination of the winding. Steps can then be taken to insulate or replace the coil.

A *shorted* or *open* coil can be found by testing the armature as shown in Fig. 15. A small buzzer is connected to a few cells of dry battery and leads brought out from both sides of the interrupter. These leads are taken to a set of contacts fastened to a leather strap that passes around the commutator. A receiver fitted with two pointed prods is used for making the test.

When the buzzer is operated and the prods placed an adjacent segments, a certain note will be heard in the receiver. The entire commutator should be tested by shifting the prods from segment to segment and noting if *every two segments gives the same signal strength* in the 'phones. A loud note between any two segments indicates that the coil between them is *open,* while no note or a very weak note shows a *short-circuited* coil.

Should the open be in the winding itself it can be repaired temporarily by bridging the two segments with a short length of wire or a drop of solder. A shorted coil will cause the coil to heat and eventually burn out; it should be opened if possible, shorting the segments to which it is attached, as previously mentioned.

A discharged battery may be due to the generator not furnishing enough current to properly charge the cells. A method to test for this trouble is to connect the ammeter in the circuit, as shown in Fig. 10. The meter will indicate the output of the machine at the terminals. The meter should then be shifted to the position shown in Fig. 11, and will then indicate the current actually delivered to the batteries. The readings should be the same in both cases unless current is used for ignition, when an allowance should be made. Should the difference be unreasonably large the trouble lies with the wiring or the automatic cut-out switch.

Where the vibrating type of regulator is used the contacts often become burned and blackened, causing the field circuit to increase in resistance or become opened. When cleaning or dressing regulator contacts be careful not to change the tension of the spring on which the contacts are mounted.

Should the machine fail to give the proper output the trouble may be due to any of the defects mentioned in connection with the motor. Open fields or armatures are seldom found in the machine itself, open fields being due mostly to faulty contacts on regulating appliances. The tests for a generator armature may be made in the same manner as those for trouble in the motor armature. Some cars are fitted with the motor and generator in one unit, but the method of testing is not varied on this account.

The method for testing a single wire system for a poor *ground connection* is shown in Fig. 9. Should the meter indicate a drop the ground connection is poor. The parts should be well cleaned and covered with white lead, then tightened up again.

A ground on a two-wire system can be detected as shown in Fig. 12, by using the 'phone tester. A click in the receiver indicates a ground and the various circuits should be switched off until the circuit giving the trouble is found, and by tracing it out the trouble located exactly and removed.

A leak can also be detected by using the ammeter as shown in Fig. 13, with all switches open. An indication on the meter shows a short circuit or ground on the leads to the switches, which can also be found by tracing the wires.

This covers the field of automobile testing in a general way, and any trouble not mentioned can be readily located after becoming familiar with the instruments. The proper care of the various parts of the equipment will go a long way toward the prevention of trouble.

Care of Motors and Generators

Cleanliness is the first essential in electrical apparatus; therefore the motor and generator should be kept clean and free from dirt. Do not put any lubricant on the commutator. This only accumulates dust and in low-voltage machines reduces the output appreciably. Keep the brushes and commutators clean and see that they make good contact at all times. See that the brush arms move freely, and that there is sufficient spring tension to hold the brushes firmly against the commutator, even when undergoing vibration from the engine. The generator must be kept in good condition to properly charge the battery.

Care of Storage Battery

Add nothing but pure water to the batteries and do so often enough to keep the solution above the plates. Distilled water is preferable for the purpose, but rain water may be used if it has not been in contact with metal for any length of time.

Keep battery charged, taking hydrometer readings to check its condition at least once a week. Do not use the cranking system to excess. When the starter is used often it will become necessary to give the battery a charge from some outside source from time to time.

Note the ammeter readings on the dash to check the charging of the battery. Any falling off in the output should be corrected at once.

Continuous operation of the battery in an over-discharged condition may damage the battery beyond repair, necessitating replacement of plates or of the entire battery. The only way to avoid this is to keep the battery fully charged at all times.

Become a Doctor of **Chiropractic**
Advanced Science of Spinal Adjustment

This is the day of drugless healing! In Chiropractic—treatment of disease by spinal adjustment—Science has made a forward step. Look at the newspapers and magazines—note the trend toward the principles of drugless healing, especially Chiropractic.

You can now become a Doctor of Chiropractic **through home study during spare time!** We teach you thoroughly either by mail or in class. You can know **independence and position!** Makes no difference where you live or what you do—you should be able to qualify for this great profession. Some of our graduates report that they

Earn $3,000 or More a Year

Dr. M. D. Moore, Ky., writes of having 17 patients in one day at $2 each. Dr. L. H. Roche, New Jersey, $5,550 a year. Dr. A. H. Morrow, of Illinois, reports earning $22 a day. We could name many other Chiropractors who are making good incomes. See the facts in our Free Book. It's only a question of preparation on your part, to enter a profession that is paying others $3,000 to $5,000 or more a year. Think what it would mean to you to earn such an income and to be your own boss with your own hours. Isn't this the kind of life you are desirous of leading? Well, it is now within your reach. Truly this is a chance for you!

22 CHARTS FREE

$15 Set of 8 Anatomical Charts and $16.50 Set of Nerve and Pain Area Charts

Yes, free to you without a cent, now or later. As an inducement to secure quick action, we will give absolutely free, our big, 72-page book; a $15 set of eight Anatomical Charts, beautifully lithographed in lifelike colors, and also a complete set of colored Nerve and Pain Area and Concussion Charts, regular value, $16.50.

Our Lessons Teach You How to Make Spinal Adjustments for the Speedy Relief of

Headache	Neuralgia
Indigestion	Neuritis
Lumbago	Catarrh
Epilepsy	Fevers
Pleurisy	Jaundice
Constipation	Dyspepsia
Rheumatism	Paralysis

Asthma, etc.

Learn At Home In Spare Time

We train you by mail. You can learn at home in your spare time. You receive the personal instruction of men who are prominent in this great profession. Give us a portion of your spare time, and we will quickly train you to become a Doctor of Chiropractic, ready to step out and take your position of prestige in the world.

Mail Coupon NOW! Why slave your life away in work that you don't like—work that doesn't fit with your ambition? Here's the chance you've been looking for—the opportunity your ambition has sought! Mail coupon today and see the success that may be yours as a Doctor of Chiropractic. Don't delay.

AMERICAN UNIVERSITY
Manierre Bldg, Dept. 222 Chicago, Ill.

Without cost or obligation, send me by mail, postpaid, your new illustrated 72-page book, and your Free Charts Offer.

Name.....

Street and No.....

City..... State.....

Don't Wear a Truss

BROOKS' APPLIANCE, the modern scientific invention, the wonderful new discovery that relieves rupture will be sent on trial. No obnoxious springs or pads. Has automatic Air Cushions. Binds and draws the broken parts together as you would a broken limb. No salves. No lies. Durable, cheap.

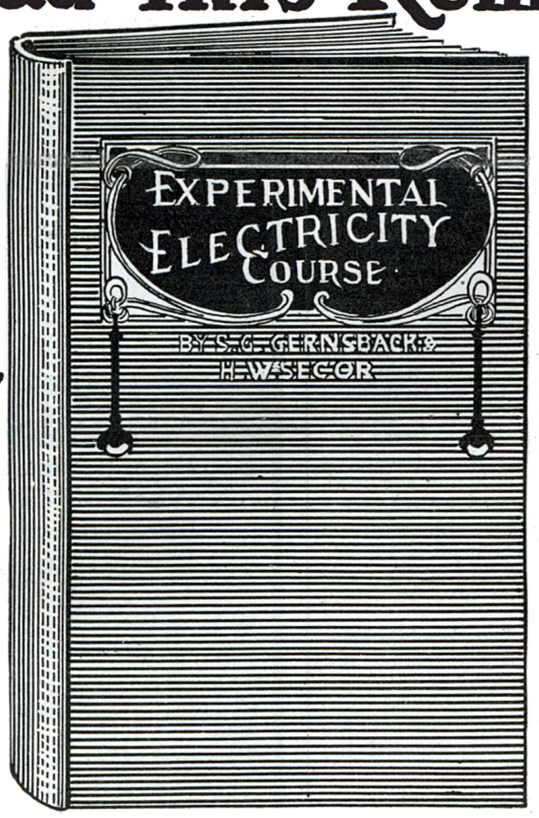
Sent on trial to prove it. Protected by U. S. patents.

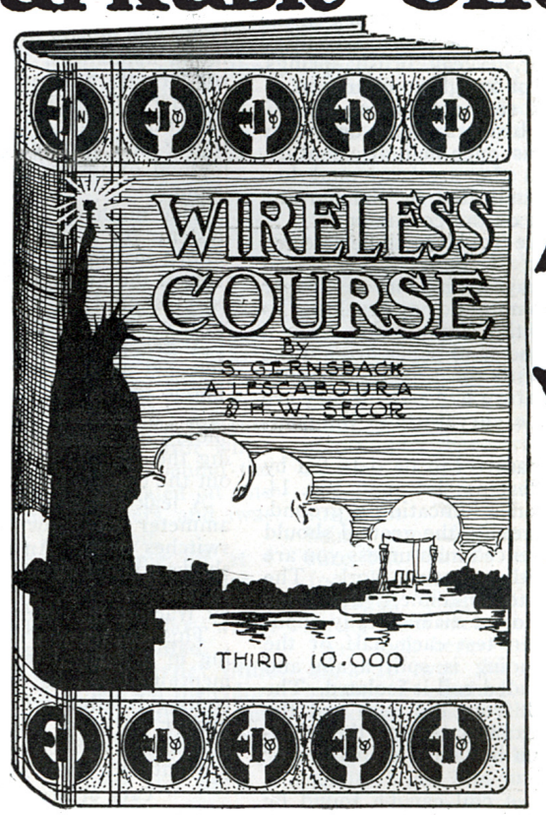
Catalogue and measure blanks mailed free. Send name and address today.

C. E. BROOKS, 203A State Street, Marshall, Mich.

Free to You!

Read this Remarkable Offer!



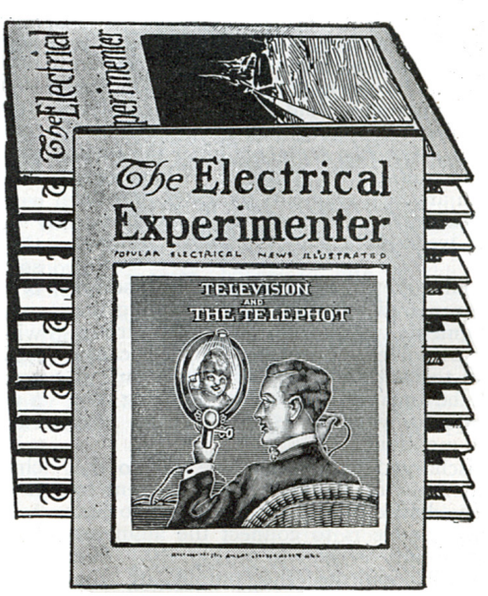


This masterpiece contains 160 pages, 400 illustrations. Size of book 5"x9". Printed on extra thin paper, so book can be slipped in pocket. Handsome stiff cloth cover. **FREE** with a year's subscription.

The most comprehensive Wireless Course ever printed. Contains 160 pages, 350 illustrations. Size of book 6½" x 9". Very fine flexible linen cover. **FREE** with a year's subscription.

This is a very limited offer. It may be withdrawn at any time, due to the tremendous cost of paper, which IS JUST DOUBLE WHAT IT WAS ONE YEAR AGO. We only have about 2000 each of these fine books on hand; after they are gone we cannot reprint the books until conditions become normal again. THIS MAY BE TWO YEARS OR MORE. **Now is your chance.**

The publishers of this journal have earned an enviable reputation of giving more than 100 cents' worth for each dollar spent with them. Profit by this liberal opportunity NOW; it may never be made again.



HERE'S THE OFFER

Subscribe to THE ELECTRICAL EXPERIMENTER for one year, at the regular subscription price of $1.50 per year (Canada, foreign and N. Y. C. $2.00) and we will send you FREE, POSTPAID, either one of the above books. If you subscribe for two years, BOTH BOOKS WILL BE GIVEN FREE, POSTPAID.

If you are a subscriber at present, take advantage of this wonderful opportunity anyway. If you do, we will extend your present subscription for one year.

This Offer Limited. Act Now.

FILL IN — TEAR OUT — AND MAIL

5-18

Gentlemen:

Please enter my subscription to THE ELECTRICAL EXPERIMENTER for the term of.....year..... for which I enclose herewith $.....
You will also send me at once FREE prepaid your.....book....

.....

.....

Name.....

Address.....

.....

EXPERIMENTER PUB. CO.,
223 FULTON STREET
NEW YORK CITY

12 copies of THE ELECTRICAL EXPERIMENTER make a book 9" x 12" and 4" thick. This book will weigh 7 lbs. It is the greatest Electrical and Wireless reference work in the world. And all for **$1.50**

Opportunity Exchange

YOU will probably find more opportunities and real bargains in these columns than anywhere else in the country. Most good things in life are hard to find and worth going after—these little ads illustrate that point; you alone will be the real loser if you don't take the time to scan through these columns.

Advertisements in this section six cents a word for each insertion. Count 7 words per line.

Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent. discount for 6 issues, 20 per cent discount for 12 issues from above rate. Objectionable or misleading advertisements not accepted.

Advertisements for the June issue should reach us not later than April 22.

OVER 100,000 PEOPLE READ THIS JOURNAL

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

AERONAUTICS

AERIAL AGE, America's leading illustrated weekly, presents the latest developments in aeronautics throughout the world. Up to the minute technical information concerning aero-engines, aeroplanes, accessories and patents. Complete model news and instruction. Trial subscription six months, twenty-six issues, one dollar. Sample copy 10c. Aerial Age, 280 Madison Ave., New York City,, N. Y.

AGENTS WANTED

I'LL GIVE YOU $20 CASH for a few hours' work introducing my new FAMOUS PATRIOTIC PICTURES. Send 10c for regular 25c sample and start at once. $5.50 cash if you sell only 30. Particulars free. F. Clement Moore, Pub., New Egypt, N. J.

AUCTIONS

AUCTIONEERS make from $10 to $50 a day. Free catalog. Missouri Auction School, Kansas City.

BOOKS

TO GET BETTER PICTURES: Read the Amateur Photographer's Weekly; illustrated; weekly prize competitions; print criticisms; many unique features; $1.50 per year; three months' trial subscription 25c.; Abel Publishing Company, 401 Caxton Bldg., Cleveland, Ohio.

A BINDER for THE ELECTRICAL EXPERIMENTER will preserve your copies for all time. Price, 50c. Postage on 3 lbs. is extra. Send for one today. Experimenter Publishing Co., 233 Fulton St., New York City.

FIRE SALE OF SLIGHTLY DAMAGED BOOKS. Due to fire in our stock rooms, a great many of our books were water stained, but not otherwise damaged. Rather than dispose of them to dealers we prefer to give our readers the benefit. Look at this list! Our celebrated Wireless Course, 160 pages, 400 illustrations; Experimental Electricity Course, 160 pages, 350 illustrations; How to Make Wireless Sending Instruments. These three books for $1.00 prepaid. Regular selling price of these three books is $2.50. We guarantee you will be satisfied. Experimenter Publishing Co., Inc., 233 Fulton St., New York City.

OLD E E. BACK NUMBERS. We have some valuable old E.E. back numbers on hand as per list below:

1915.				Oct.	.....price each		$.35
Jan.	....price each		$.35	Nov.	...	" "	"
March	.. "	"	"	Dec.	....	" "	"
April	... "	"	"	1917.			
June	... "	"	"	Jan.	....	" "	$.35
July	.... "	"	"	Feb.	....	" "	"
August	. "	"	"	March	..	" "	"
Sept.	... "	"	"	April	...	" "	.20
Oct.	.... "	"	"	May	...	" "	"
Nov.	... "	"	"	June	...	" "	"
Dec.	.... "	"	"	July	....	" "	"
				Aug.	...	" "	"
1916.				Sept.	...	" "	"
Jan.	.... "	"	$.35	Oct.	....	" "	"
Feb.	.... "	"	"	Nov.	...	" "	"
March	.. "	"	"	Dec.	...	" "	"
May	.... "	"	"	1918.			
June	... "	"	"	Jan.	....	" "	$.20
August	.. "	"	"	Feb.	...	" "	.15
Sept.	... "	"	"	Mar.	...	" "	"
				April	...	" "	"

We can fill orders at once upon receipt of your remittance, and if you have not these numbers already now is your chance to get them, as they probably will be snapped up very quickly. Experimenter Publishing Co., 233 Fulton St., New York City.

BUSINESS OPPORTUNITIES

SPECIAL OFFER—Luminous Paint, 15c; Silver-plating Powder, 15c; Liquid Courtplaster, 15c; Soap Bubble Liquid, 15c; Straw Hat Bleach, 15c; Collapsible Tube Tooth Paste, 15c; Resilvering Mirror Liquid, 15c; Polish for Tan Shoes, 15c; Dressing for Tan Shoes, 15c; Paint to Make Oil Cloth, 15c. Full Directions how to make and use. Full set of 10 only 50c. Remarkable bargain. Stamps accepted. Sidney Specialty Co., 233 S. Fulton St., New York City.

CHEMICALS

PREPAID 80 DIFFERENT CHEMICALS, $4.00—Mercury, Sodium, Iodine, Magnesium, Aluminum, Uranyl-Chloride, Silver Nitrate, Mercuric-Oxide, Zinc Dust, Iodoform, Manganese Dioxide, Calcium Sulphide, Hydrochloric, Oxalic and Acetic Acids together with 65 others. All are contained in glass bottles. Generous quantities of each. We do this to advertise the purest chemicals manufactured. Full list sent free upon request. Sent prepaid to any address in the world, 54 complete. C. O. D. terms accepted. The Swimmer Chemical Co., 1849 Park Place, Brooklyn, N. Y.

EXPERIMENTAL CHEMISTS!! Perform chemical experiments with apparatus described in "Experimental Chemistry." I sell any piece of apparatus you need. Each and every piece guaranteed. GLASS STOPPERED REAGENT BOTTLES with name and symbol blown in. One quarter pint. Special price $3.50 per dozen, 40c each. Send for list. John F. O'Brien, 149 Valley Road, Montclair, N. J.

Do These "Ads" Pay?

Brooklyn, N. Y. 1904 *Park Place*
The Experimenter Publishing Co.,
233 Fulton St.,
New York City.

Gentlemen:

In reference to our advertisements in the "Electrical Experimenter" regarding our chemical laboratories: we are pleased to inform you that we have met with very excellent results.

We have advertised in a great number of magazines and we find the Electrical Experimenter to be the most reliable of all, and we chiefly owe our success to this publication.

We therefore recommend this magazine as an advertising medium to those who desire to increase their business, we beg to remain

Yours respectfully,
The Swimmer Chemical Co.
J. C. SWIMMER.

EXPERIMENTERS! Are you interested in novel chemical experiments? Send 25c for large collection. Merel Sager, 44 Apple St., Tiffin, Ohio.

LABEL YOUR CHEMICALS — 150 different gummed chemical labels printed with names and molecular formulas. 16c postpaid. May list of Chemicals, Laboratory Apparatus, and Technical books, 5c. H. Klaus, Eureka, Ill.

HELP WANTED

U. S. GOVERNMENT WANTS HELP—Men, women, 18 or over, $100 month. Quick advancement. Thousands war positions open. Easy work. Write immediately for free list positions. Franklin Institute, Dept. 027, Rochester, N. Y.

MEN WANTED to make Toy Soldiers, Army, Navy and other toys. Home-workers on small scale. Manufacturers on large scale. Greatest chance for industrious people for independent business. Enormous demand and future in American Made Toys. War stopped all importation. Another industry taken from Germans. Export for 1917 about $3,000,000.00. Toy industry growing rapidly. Some people started small, own factories now. We buy these goods till Christmas, for three years, paying fixed prices. Experience or tools not necessary. Hundred and more made complete per hour. Casting form outfit $2.75 up. Booklet and information free. Toy Soldier Manufacturing Co., Union Square, New York.

ELECTRICAL SUPPLIES AND APPLIANCES

QUALITY ELECTRIC FIXTURES that will modernize your home—at lowest prices. Send stamp for Illustrated Catalog. SPECIAL PRICES ON IRONS, TOASTERS, etc., for May. Write for Circulars. Baer Electric Co., Van Wert, Ohio.

100 Induction Motor Winding Diagrams; 1, 2, 3 phase; Star Delta, 2 to 12 poles inclusive. Post paid, $5. E. Glass, 2819 East 8th St., Kansas City, Mo.

AVOID BATTERY EXPENSE—A telephone generator will operate your induction coil and increase the spark length from 10 to 100%. Wiring diagram and complete instructions sent postpaid for $1. Harry Huffman, Toledo, Ill.

EXPERIMENTERS! Here is your only chance to obtain super-sensitive microphones for operating devices such as lamps, motors, telegraph inkers, etc., by sound waves from a distance. These marvelous super-sensitive microphones will be sold at the extremely low price of $3. J. Camps, 30 Pine St., New York, N. Y.

AMATEURS, ATTENTION!!!
We have on hand a small quantity of slightly damaged pure Bakelite bases. Bases are new, except slightly imperfect at one side, edgewise.
Size 5½x7¾x¼ inch thick. Each 50c.
Size 4¾x4¾x¼ inch thick. Each 30c.
Send sufficient amount for postage. Electro Importing Co., 231 Fulton St., N. Y. C.

MOTORCYCLES

MOTORCYCLES FROM $25 UP—New and second-hand. Easy terms, large list to choose from, all makes. Send 4c stamps for Bulletin "A." Peerless Motorcycle Co., Watertown, Mass.

PATENT ATTORNEYS

INVENTIONS WANTED! Manufacturers constantly writing us for patents. List of inventions actually requested and book "How to Obtain a Patent" sent free. Send rough sketch for free report regarding patentability. Special assistance given our clients in selling patents. Write for details of interest to every inventor. Chandlee & Chandlee, Patent Attorneys, Est. 21 years. 551 7th St., Washington, D. C.

YOUR IDEA WANTED. PATENT YOUR INVENTION. I'll help you market it. Send for 4 free books, list of patent buyers, hundreds of ideas wanted, etc. Advice free. Patent advertised free. Richard B. Owen, Patent Lawyer, 130 Owen Bldg., Washington, D. C., or 2278-T Woolworth Bldg., New York.

PATENTS ON EASY PAYMENTS. Send model or sketch for Free Search and Certified Registration of Your Invention for Your Protection. Free Book Tells What to Invent and How to Obtain a Patent on Easy Payments. C. C. Hines & Co., 593 Loan & Trust Bldg., Washington, D. C.

PATENTS—Without advance attorney's fees. Not due until patent allowed. Send sketch for free report. Books free. Frank Fuller, Washington, D. C.

MILLIONS SPENT ANNUALLY FOR IDEAS! Hundreds now wanted! Patent yours and profit! Write today for free books—tell how to protect yourself, how to invent, ideas wanted, how we help you sell, etc. 212 Patent Dept., American Industries, Inc., Washington, D. C.

INVENTORS, you need my free book, "Patents and Successful Promotion." Tells how your ideas can be turned into money. Honest advice free. Real personal service. Highest references. Lloyd W. Patch, 26 Le Droit Bldg., Washington, D. C.

PHONOGRAPHS

BUILD YOUR OWN PHONOGRAPHS and manufacture them for profit. Drawing, Instructions, Parts, Price List, Blue Print, etc., complete, sent free upon request. Write today. Associated Phonograph Co., Dept. E-1, Cincinnati.

MISCELLANEOUS

STAMPS—61 all different, free. Postage 3c. Mention paper. Quaker Stamp Co., Toledo, Ohio.

HOW to become a successful inventor—Free Particulars. Engineers, 2548 Armitage, Chicago.

FOR SALE—Newly invented telegraphic code, Registered U. S. Patent Office, none equal to simplicity, speed and accuracy. Comprised of only four lessons. Clayton Van DenBerg, 809 Fulton Street, Grand Haven, Michigan.

HARD RUBBER JARS for automobile storage batteries, per dozen assorted, $6.50. Vent plugs per dozen, 30c. Have tools and supplies to exchange. Want two-inch coil or larger, and Tesla Coil. Gus Margreiter, 120 E. Harrison, Kirksville, Mo.

SPRING CALIPERS—Inside, Outside Dividers. 4-inch size. Set of three, $1. Money-back guarantee. Every mechanic needs this set for accurately working. LARKIN COMPANY, 1988 Bedford Ave., Brooklyn, N. Y.

INVENTORS! ATTENTION!—I have valuable information how you can protect your inventions for two years before patenting it without expense or risk, full instructions, 25c. H. B. Lambert, 55 Willow Ave., North Pelham, N. Y.

SPECIAL—Join the Buyer's and Seller's Exchange! 25c will put your name and list of articles you wish to sell on our files. Thousands already on file. Results certain. Cheaper than advertising. Your name sent to every inquirer until articles are sold. Buyers, send stamp and description of article wanted and receive list of names free. Join now. The Buyer's and Seller's Exchange. P. O. Box 931, Indianapolis, Ind.

WE HAVE FOR SALE the following Revolving Armature Type Westinghouse Generator, which is in good condition, having seen less than six months' service. 200 K.W. 2,200 volts, 3 phase, 60 cycles, 600 R.P.M., 53 amperes per terminal, complete with slide base, pulley, exciter, and switchboard complete with ammeter, voltmeter and controlling devices. Exciter is 3 K.W. 1,320 R.P.M.; serial number of generator is 579046. Price $2,000.00 Kindly advise at once if interested. Immediate delivery of the outfit can be made. Bimel Spoke & Auto Wheel Co., Portland, Indiana.

WE HAVE a limited number of beautiful art pictures on hand of Nikola Tesla, and Dr. Lee De Forest. These make a handsome decoration for any laboratory or workshop and should be prominently displayed. Price for both, prepaid, 10c. Experimenter pub. Co., 233 Fulton St., New York City.

MOTION PICTURE FILM—Best stories and comics, $5 per 1,000 feet, also 1c a foot. Harrison, 1283 Lakeland Ave., Lakewood, Ohio.

PRINTING

YOUR name on fifty "Styloprint cards," 35c. Card case FREE. Imprimatur Press, Waltham, Mass.

TELEGRAPHY

TELEGRAPHY—Both MORSE AND WIRELESS: STATION AGENCY, taught quickly. TREMENDOUS DEMAND—greater than supply. PERMANENT POSITIONS SECURED—BIG SALARIES. IDEAL WORKING CONDITIONS. GREAT OPPORTUNITIES FOR ADVANCEMENT. WOMEN OPERATORS also needed. All expenses low—can earn living while attending. Oldest and largest school—established 44 years. Endorsed by Railway, Western Union and Marconi officials. Now offering special three months' Radio course for young men subject to draft, enabling them to enter Signal Corps—"PREFERRED SERVICE." Large illustrated catalogue free. Correspondence courses also. Write today. ENROLL IMMEDIATELY. DODGE'S INSTITUTE, Lone St., Valparaiso, Indiana.

Scientific Exchange Columns

UNDOUBTEDLY you have at the present time some things for which you have no further use. Do you wish to exchange them for something for which you have immediate use? There is no surer and quicker way to do this than by advertising your articles in these columns. The *Very* people, the *Only* people, who could possibly have a use for your things read this journal. More than 75,000 interested people will see your ad. It is furthermore the cheapest advertising medium for you in the country. Dealers advertising accepted in Opportunity Exchange columns only.

The rates are: *Five cents per word* (name and address to be counted), minimum space 3 lines. Count about 7 words to the line. *Remittance must accompany all orders.* No advertisement for less than 50c accepted.

We reserve to ourselves the right to refuse any advertisement which we consider misleading or objectionable. Advertisements for the June issue should reach us not later than April 22.

The Classified Columns of the "Electrical Experimenter" Bring Positive Results

Subscribers experiencing trouble in dealing with any advertiser should notify the publisher very promptly.

OVER 100,000 PEOPLE READ THIS JOURNAL

AEROPLANE—Curtis pusher type $300, or complete with motor $1,200. For photo and description write H. A. Margreiter, Kirksville, Mo.

WISH TO COMMUNICATE with party having a patented small article, likely good seller, one easily manufactured; or party having similar article or device and wants to patent or sell. Not answering cranks. H. Jones, 1633 Anapuni St., Honolulu, T. H., U. S. A.

SELL—Lionel Train (No. 6) with coaches, $14. Machine for showing postcards, $6. Foot-power lathe with chuck and scroll-saw, etc., $6. Articles in A-1 condition and almost new. O. Dickson, 8607 Poplar St., New Orleans, La.

GOOD BOOK on Electric Meters. Sampson Wet Batteries, Loading Coil, Radioson, Galena Detectors, Speedometer, back numbers EXPERIMENTER, Hydrometer. Sell or trade. Menier, 443 East 85th St., New York City.

SELL—Large wireless receiving set, boy's books, magazines, Ive's electric train, toy motors. Write. Ernest Smalley, Martinsville, N. J.

SHORTHAND—Like March EE, page 787. Completed course. Sell $1. Smith, 71 Sheridan, Brooklyn, N. Y.

WANTED—Printing press and type. State size, condition and price in first letter. Have phonograph parts, low voltage transformers, etc. Robt. J. Hedstrom, Racine, Wis.

FOR SALE—Seneca Plate Camera, 4 by 5, and full equipment. Good as new. First money order for $15 takes it. Particulars free. Rannells & Rannells, Points, W. Va.

BARGAIN—Will sell Smith Motor Wheel, which has been run only 500 miles, for $30 cash. Theron Baumann, Kimball, S. D.

FOR SALE OR EXCHANGE—One latest improved 8 H. P. Traction Gasoline Engine Vacuum Cleaner, complete with tools and 120 ft. steel reinforced vacuum hose; hose box mounted on two-wheeled cart; cost $365, sell for $180, or what have you to trade? Write for particulars. Change dust into money, $2 per hour. One 4 x 5 Double Rectilinear Lens equipped with Bausch & Lomb shutter, almost new; $10 takes it. One Heinze LT4 Magneto with Coil No. 13C, in very good condition, costs $55; will trade for ½ H. P. 110-115 V. 60-cycle A. C. Electric Motor. Must be in good condition. One 7 M M Sporting Mauser Rifle in good condition, $8. One Acme Magneto Generator J S with flat belt governor pulley, $7. One 110-115 V. D. C. shunt wound 1/6 H. P. General Electric Co.'s motor, can be used as generator, revolutions 2300, in fine condition; $15 will take it. A. F. Malliek, Box 1082, Jamestown, N. Dak.

FOR SALE—22 Remington Special Rifle, $10. Set 4 Zobo Horns, $5. Silver French Cornet, $15. 6 vol. Home Library Law, $6. 22 Single Shot Winchester, $3.50. Attlesey, Anacortes, Wash.

BARGAIN—2 cylinder 3 H. P. air cooled gasoline-kerosene engine. Light weight. New bearings. Ernest Jordan, Eureka Springs, Ark.

"WANT TO SWAP"?

Do you realize that these "Scientific Exchange Columns" are the World's most renowned "Swap" market? "THE ELECTRICAL EXPERIMENTER" prints 100,000 copies of this issue; that means that at least 180,000 readers see this page and probably a great many more. Our readers who advertise here seldom advertise the same thing twice—usually within five days after the issue is out the advertised article has been sold, or swapped. The many testimonials which we print here from time to time are ample proof of the almost miraculous pulling power of these columns.

Look around in your attic or workshop and you will find dozens of long forgotten articles, useless to you now, but very useful to someone else. At a ridiculously low cost you can either sell or swap such articles.

And remember this fact: The U. S. Postal Laws protect you. No one can "do" or cheat you. Of 3,495 "ads" published in these columns during the past five years, only twelve complaints were reported to us, and each and every one was adjusted to the full satisfaction of the complainant.

It matters not if you have old books or magazines, a kodak, electrical or chemical apparatus, scientific instruments, bicycles, typewriters, moving picture machines, air rifles, watches, structural toys, etc., etc. All these and countless others can be speedily disposed of here. Try it and be convinced.

Montezuma, Iowa.

Experimenter Publishing Co.,
233 Fulton St.,
New York, N. Y.

Dear Sir:

I am taking this opportunity to write you concerning the results obtained from my ad which was placed in the Exchange Columns of the ELECTRICAL EXPERIMENTER some few weeks ago. I was very much surprised at the number of answers which I received; some one hundred in all. These came from all parts of the country, including Canada and Honolulu, T. H. I will surely recommend it to all who wish to sell apparatus of any sort.

Yours very truly,
RAY J. FARMER.

EXCHANGE for Wireless Apparatus or sell for cash, $60 worth Lionel Toy Trains. Wm. Schafer, 6255 Frankstown Ave., Pittsburgh, Pa.

FOR SALE—Magneto, Camera, 10 books, to exchange for electrical goods. Write, John Dietrich, Bowdon, N. Dak.

FOR SALE—Motor Boat Receiving Set described in April issue of this journal. A bargain. F. MacMurphy, Wheaton, Minn.

FOR SALE—First $15 takes No. 3 Emerson typewriter. Slightly used. C. E. Mosier, Juniata, Nebr.

FOR SALE—Excelsior Motorcycle, $50. Baby Pope, $30. Might consider trade. Send stamp for photos. Lawrence Johnston, Fairfield, Ill.

WANTED—Good telescope. State size. Albert Larson, River Falls, Wis.

FOR SALE—Electro Vario Selective Coupler (cabinet), new, $5. Wm. Liddle, Hackensack, N. J.

BARGAINS—Cabinet Receiving Set, Audion, Loading Coils, Variables, Switches, Railroad Relay, Key, Sounder, etc. Write for list and prices. Harold Spencer, East Concord, N. Y.

FOR SALE—6 H. P. 4 cylinder 4 cycle gasoline engine with magneto and carburetor, $27.50. D. Frank, 706 N. Meridian St., Indianapolis, Ind.

TRADE—Set Hawkins Guides, tools, wireless instruments, value $19, for good running condition motorcycle engine. Edwin Widmer, 2910 N. Lawrence St., Philadelphia, Pa.

LIONEL TRAIN OUTFIT—A fine large outfit in A-1 condition. Complete with all accessories as switches, crossings, semaphores, bumpers, 2 gondola cars and 95 feet of track. Standard gauge. Further information on request. Vernon Chaberd, 362 Custer Ave., Youngstown, Ohio.

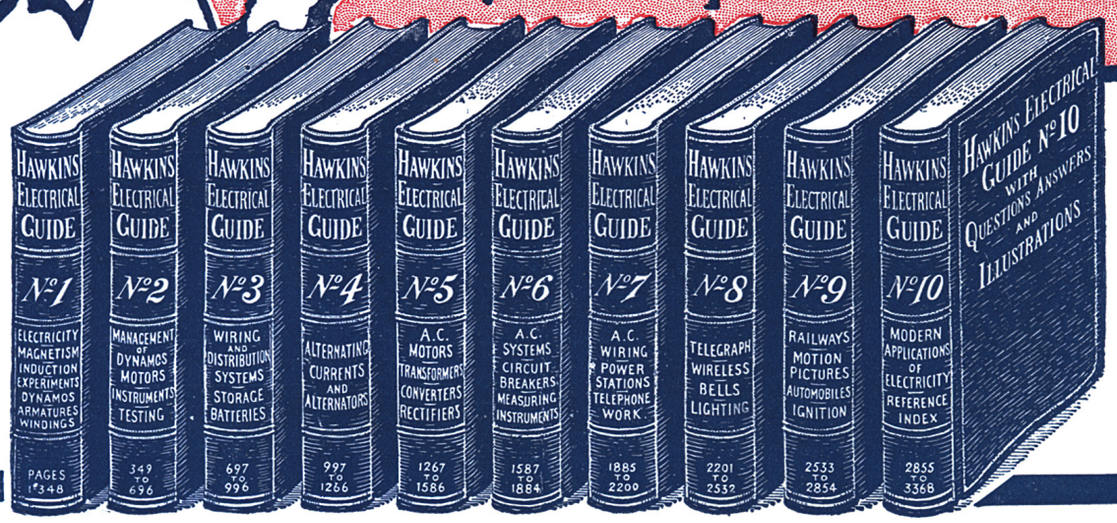
FOR SALE—Edison Projecting Kinetoscope Exhibition Model. Write Louis Hein, 2506 E. Ward St., Seattle, Wash.

WILL SELL or swap for anything electrical, new $15 snaredrum with stand, and 20 boys' books. Earl Brown, 514 Virginia Ave., Martinsburg, W. Va.

FOR SALE—$18 Analytical Balance and Case, $10; $10 Volt-Ammeter, Graduated 25 volts-amperes, $5; $8 Transformer for small voltages, 2-20, $5; $30 Portable Weston Triple Range Volt-Ammeter and Case, graduated from 10 amperes and volts to 30 volts and 300 amperes, $20; 6-volt Knapp Dynamo-motor, $3. A. R. MacPherson, 1107 South K St., Tacoma, Wash.

WANTED—Copy of book "Michael Faraday, His Life and Work" by Sylvanus Thompson. Also an ohmeter of the Roller-Smith type or a Wheatstone bridge; must be in first-class condition, and include galvanometer. H. W. Secor, c/o ELECTRICAL EXPERIMENTER, 233 Fulton St., New York City.

Every Electrical Man Wants These Books and we ship them for your inspection FREE



Flexible Covers — Handy Pocket-Size Volumes

10 Volumes 3500 Pages 4700 Pictures

$1 Per Volume

$1 Per Month

Just what you need to know to succeed in ELECTRICITY

EVERY electrician, every engineer, every mechanic should know about these wonderfully helpful instructive books, which give in plain words a complete working knowledge of electrical engineering in all its phases.

You run into some new electrical problem almost every day. The information you need to help you in your every day work is in

HAWKINS ELECTRICAL GUIDES

These books place electricity at your finger ends. They cover every imaginable subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain every day language—no wasted words—only what you need to know—chock full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering. They will help you in every detail of the day's electrical work. You can't ask an electrical question that Hawkins Guides can't answer.

READ THIS PARTIAL LIST OF CONTENTS

No. 1 Contains 348 pages, 388 illustrations. Electrical signs and symbols—static and current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamo and motors—galvanometers—standard cells—current measurement — resistance measurement — voltmeters — watt-meters—watt hour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages, 423 illustrations. Distribution systems—wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles—alternating current diagrams—the power factor—alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors—induction motors, transformers; losses, construction, connections, tests—converters—rectifiers, etc.

No. 6 Contains 298 pages, 472 illustrations. Alternating current systems—switching devices—circuit breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards, etc.

No. 7 Contains 316 pages, 379 illustrations. Alternating current, wiring power stations—turbines; management, selection, location, erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony—wireless—electric bells—electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc.

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro plating—electro-therapeutic—X-rays, etc.

Also a complete 126-page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides. There are over 13,500 cross references. You find what you want to know instantly.

What Electrical Men Say

Helped Him Make Good

"It is only right for me to recommend highly the Hawkins Guides, for they have been of the greatest assistance to me in placing me in my present position as Superintendent of Construction Department of one of Ohio's largest Electrical Companies. I would like to see every man have a set of Hawkins Guides."
Geo. Knecht, Columbus, Ohio.

In the Naval Electrical Dept.

"The Hawkins Guides are great help to me in the Naval Electrical Department, which they cover very thoroughly."
C. J. Cornell,
U. S. Receiving Ship, Brooklyn, N. Y.

Superintendent

"I am now superintendent of the Dunnville Hydro-Electric Systems, and Hawkins Guides were a great help to me in holding down a responsible position."
W. E. Swartz, Dunnville, Ontario.

Wireless Operators

"I have worked wireless for ten years—but I wish I had these books years ago, as they have saved me a great deal of trouble." H. Marshall.
Steamer M & B No. 2,
Walkerville, Ont.

Pocket-Size Flexible Covers

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers.

You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use you will never again want to be without them. Try it at our expense.

SEND NO MONEY

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us **nothing.**

When you decide to keep them you only have to pay $1.00 down and remit the balance of $9.00 on the easy payment of $1.00 a month till paid for.

Use this coupon to get the books. It will pay you many times over.

THEO. AUDEL & CO.
72 Fifth Ave. New York, N. Y.

SEND NO MONEY- USE THE COUPON

THEO. AUDEL & CO.
72 Fifth Avenue
New York, N. Y.

Please submit me for examination Hawkins Electrical Guides (price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature .....

Occupation .....

Business Address .....

Residence .....

Reference .....E. E. Ma.

No Money In Advance

This Marvelous CAMERA

On FREE TRIAL!

Only 10,000 of these marvelous, instantaneous picture-taking and making cameras to be sent out absolutely on approval without a penny in advance just to prove that it is the most wonderful invention—the camera sensation of the age. So **you** must send for it **quick!** Just think of it—the new Mandel-ette

Takes and Makes Finished Pictures

INSTANTLY!

You press the button, drop card in developer and in **one minute** take out a **perfect, finished** post card photo 2½x3½ inches in size. Camera, itself, is about 4½x5x7 inches. Loads in daylight 16 to 50 post cards at one time.

No Films—No Plates—No Dark Room

Not a bit of the muss and bother of the ordinary kodak or camera. It is instantaneous photography! Universal focus lens produces sharp pictures at all distances. Pictures develop and print automatically. Can't overdevelop. Results positively amazing.

Better Pictures—Less Bother

I received your Mandel-ette Outfit yesterday and after trying it out today, I must indeed express my astonishment at the work that can be done with it. The first three pictures that I had taken were better than most of the snap shots that I took with a film camera, and there is much less bother and work in making the pictures. I have shown it to a number of people today and I am sure that you will be able to sell at least 75 or 100 here if you would have some way of demonstrating the goods. I am going to show my outfit to everyone that I meet and you can rest assured that I will do my best in boosting your wonder camera.

I. M. BROWN, Poplar Bluff, Mo.

Wouldn't Sell It At Any Price

I received my Mandel-ette and am much pleased with it. I took some pictures and even though it was a cloudy day, they came out just grand. I wouldn't sell the camera at any price.

SUSIE KINSEL, Gloucester, N. J.

Surprised At Fine Pictures

I am making some fine pictures with no trouble at all. All who see my Mandel-ette Camera say that it is fine and they are surprised when I make a perfect picture in one minute.

WALTER G. HERMAN, Newburg, Ore.

We Trust You

No difference who you are, where you live or what your age, we will send you the complete Mandel-ette outfit absolutely on approval and give you ten days to test it. If not satisfactory return it. But when you see what elegant pictures it takes—so quick, so easy, with no trouble at all—if you wish to keep it you simply send us $1 per month until our special price of only $5.50 is paid.

Easy Payments—No Reference

No red tape of any kind. Monthly payments so small you'll not notice them. Simply fill out and send coupon today. Send no money. No references required. Lots of fun and big profits.

No Experience Required

Plain instructions and everything complete with outfit so you can begin taking pictures the moment it arrives. We guarantee that even a child can operate it. Mail coupon now. No risk or obligation to keep camera.

Chicago Ferrotype Company,
Desk 223 Ferrotype Bldg., Chicago, Illinois

Friend Sends Order

My Mandel-ette arrived early Saturday morning O. K. Thirty minutes after it arrived I took my first picture and it was a great success. Any person after mastering your simple instructions should get good results with your Mandel-ette. I don't see how I ever got along without one.

After I had unpacked mine, my friend, Theo. Murdoch, New Petersburg, Ohio, came along and he was so enthused over it he sent for one the same morning. Several more of my friends are thinking of sending for Cameras in the near future.

HERMAN R. STOEBEL, Greenfield, Ohio.

No Chance For Mistake

Your special outfit reached me by express this morning. It sure is all you claim it to be and there is no danger of my sending it back, as the first picture I took was of my wife and two children and it is the best I have ever seen.

That was the first time in my life that I have ever tried to take a picture, in fact, it is the first time that I have ever used a camera of any kind and by following your instructions in the circular there is no chance to make a mistake.

TOMMY WEST, Louisville, Ky.

$18.00 In Two Days

I wish to say that I am well pleased with your camera. I am using my Mandel-ette this week at the Bedford County Fair. I have made about $18 so far with my Mandel-ette and today is only Tuesday.

IKE THURMAN, Jr., Shelbyville, Tenn.

Make It Pay In 2 or 3 Hours

I received your camera O. K. and am well pleased with it. I have already made some dandy pictures and I am sure I can make it pay for itself in two or three hours. Enclosed find orders for more cards.

J. B. HONEYCUTT, Beelog, N. C.

Camera Success—Want Agency

As I have bought one of your Mandel-ette Cameras and found it to be very successful in taking pictures, I wish to make application to become your agent. I have several young men here who are anxious to buy one and I will send you their orders as soon as I hear from you.

GEO. REUTIC, Ft. Collins, Colo.

More Than Paid For Itself

I am very pleased with the Mandel-ette Camera. I have made some very good pictures with it and it has already more than paid for itself.

CHAS. E. MEARS, Jasonville, Ind.

Chicago Ferrotype Company,
Desk 223 Ferrotype Bldg., Chicago, Ill.

Send me at once complete model Mandel-ette outfit including supply of post cards and instructions. I agree to examine and test it thoroughly and if satisfied pay you $1 a month until your special price of $5.50 is paid, otherwise I will return it at the end of 10 days.

Name.....

Street and No.....

Town..... State.....

THE CAREY PRINTING CO. Inc.
NEW YORK